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The State of the U.S. Coal Industry

A Financial Analysis of Selected Coal-Producing Companies With Observations on Industry Structure

UNITED STATES DEPARTMENT OF THE INTERIOR

U.S. Bureau of Mines

Information Circular 8707

The State of the U.S. Coal Industry

A Financial Analysis of Selected Coal-Producing Companies With Observations on Industry Structure

By T. T. Tomimatsu and Robert E. Johnson
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UNITED STATES DEPARTMENT OF THE INTERIOR
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THE STATE OF THE U.S. COAL INDUSTRY

A Financial Analysis of Selected Coal-Producing Companies With Observations on Industry Structure

by

T. T. Tomimatsu[1] and Robert E. Johnson[2]

ABSTRACT

This Bureau of Mines paper discusses the corporate structure dynamics, methods of financing, and financial assessment approaches that should be utilized to evaluate the economic health of the coal industry. It suggests rates of return and other measures of corporate economies necessary to attract capital required to finance emerging coal demand, plus impact of coal sales to total revenues.

The study illuminates the activities of 30 selected coal-producing companies, including their subsidiaries or affiliates, that were responsible for approximately 60 percent of the total U.S. production in 1974. The selected firms are not all primary coal producers; many of the larger producers are classified by the financial institutions as petroleum, metal, and steel producers, public utilities, or chemical industries.

The bituminous coal industry is highly competitive as to price, service, and quality of product and is subject to competition from other noncoal energy sources. The top 15 bituminous coal-producing companies mined about 46.6 percent of the Nation's total production in 1974, and the balance of approximately 3,885 companies were responsible for the rest of the production. Thus, the U.S. bituminous coal industry is not an oligopoly. Today, about 65 percent of the Nation's total coal production is consumed by electric power utilities and 26 percent by steel, space heating, and other industries; the balance of 9 percent is exported.

INTRODUCTION

The Arab oil embargo and pricing actions of the Organization of Petroleum Exporting Countries (OPEC) have sparked a new interest in coal. Coal is now being appreciated more and more as an abundant fuel of the future, especially since the acknowledgment of the energy crisis and the Federal Government's positive determination to reduce our energy dependence on other nations (designated "Project Independence").

Since capital is the nucleus of our minerals economy, detailed in-depth research has been conducted on the financial performance and corporate

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structure of 30 selected coal-producing companies responsible for about 60 percent of the 1974 national coal production. Of the 30 firms, the first 20 are the Nation's leading coal producers; the other 10 are medium to small coal operators. Also, from the 30 selected firms, the financial data are aggregated for 12 companies that have coal as their principal business (primary coal producers) and represent about 10.3 percent of the total U.S. production.

One of the responsibilities of the Federal Bureau of Mines is to help improve the posture of the Nation's minerals and mineral fuels and to foster and encourage private enterprise in the national interest.[3] This paper pursues this mission through financial investigation and analysis of the business organization structure. Relevant business data have been collected. This information is then used to assess the coal industry's capability to generate the huge amount of capital required for new mines, expand existing mines, and purchase mining and transportation equipment.

RATIONALE AND PURPOSE OF STUDY

The purpose of this study is to evaluate the performance (profitability) of selected coal companies to assess the economic health of the coal industry, and to determine the industry's ability to obtain the capital required to insure a dependable and timely flow of coal to meet emerging demands.

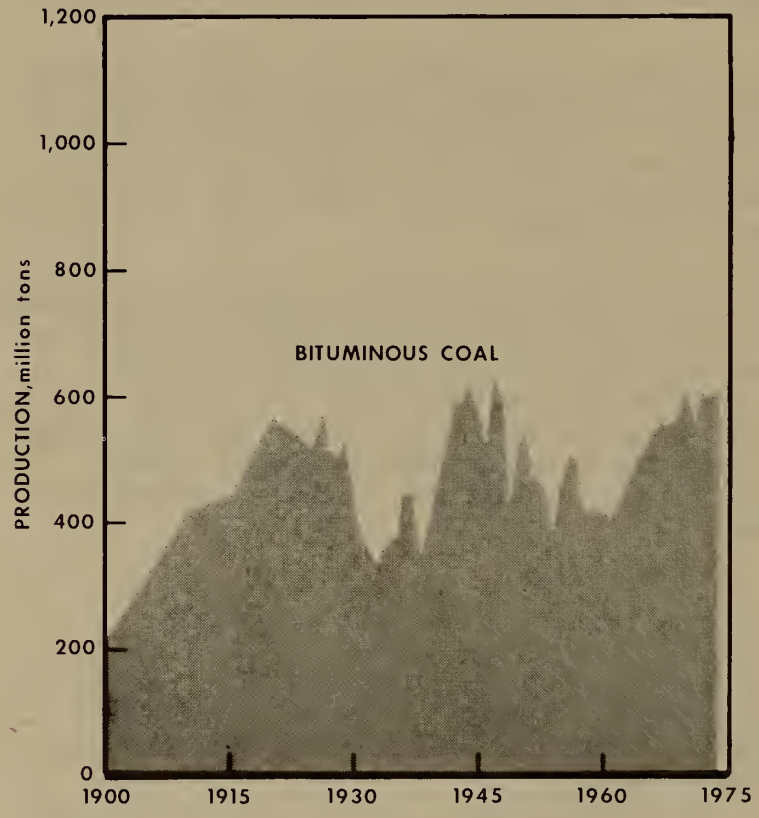

FIGURE 1. - Growth in U.S. bituminous coal-mining industry, annual production, 1900-74.

The production of coal for nearly three-quarters of a century is reported in table 1, showing the output by types of mining, and the total production since 1900 is charted in figure 1. The demand for coal has accelerated with the 1973 oil embargo, the fourfold price increase of foreign oil, and the Government's strong encouragement in the use of coal to reduce oil imports. Now, coal is destined to become increasingly important in our economy. The 1974 settlement between coal operators and the United Mine Workers should result in improved management-union relationships, a prerequisite to higher productivity.

[3]U.S. Congress. Mining and Minerals Policy Act of 1970. Public Law 91-631, Dec. 31, 1970, 84 Stat. 1876.

TABLE 1. - Growth in U.S. bituminous coal-mining industry, annual production, 1900-74, thousand tons

Year	Strip mining	Auger mining	Underground mining	Total production	Year	Strip mining	Auger mining	Underground mining	Total production
1900	-	-	212,316	212,316	1950	123,467	-	392,844	516,311
1905	-	-	315,063	315,063	1951	117,618	205	415,842	533,665
1910	-	-	417,111	417,111	1952	108,910	1,506	356,425	466,841
1915	2,832	-	439,792	442,624	1953	105,448	2,291	349,551	457,290
1920	8,860	-	559,807	568,667	1954	98,134	4,460	289,112	391,706
1925	16,871	-	503,182	520,053	1955	115,093	6,075	343,465	464,633
1926	16,923	-	556,444	573,367	1956	127,055	8,045	365,774	500,874
1927	18,378	-	499,385	517,763	1957	124,109	7,946	360,649	492,704
1928	19,789	-	480,956	500,745	1958	116,242	7,320	286,884	410,446
1929	20,268	-	514,721	534,989	1959	120,953	7,641	283,434	412,028
1930	19,842	-	447,684	467,526	1960	122,630	7,994	284,888	415,512
1931	18,932	-	363,157	382,089	1961	121,979	8,232	272,766	402,977
1932	19,641	-	290,069	309,710	1962	130,300	10,583	281,266	422,149
1933	18,270	-	315,360	333,630	1963	144,141	12,531	302,256	458,928
1934	20,790	-	338,578	359,368	1964	151,859	13,331	321,808	486,998
1935	23,647	-	348,726	372,373	1965	165,241	14,186	332,661	512,088
1936	28,126	-	410,962	439,088	1966	180,058	15,299	338,524	533,881
1937	31,751	-	413,780	445,531	1967	187,134	16,360	349,133	552,626
1938	30,407	-	318,138	348,545	1968	185,836	15,267	344,142	545,245
1939	37,722	-	357,133	394,855	1969	197,023	16,350	347,132	560,505
1940	43,167	-	417,604	460,772	1970	244,117	20,027	338,788	602,932
1941	55,071	-	459,078	514,149	1971	258,972	17,332	275,888	552,192
1942	67,203	-	515,490	582,693	1972	275,730	15,554	304,103	595,386
1943	79,685	-	510,492	590,177	1973	276,646	15,739	299,353	591,738
1944	100,898	-	518,678	619,576	1974	[e]311,097	[e]15,000	277,309	603,406
1945	109,987	-	467,630	577,617					
1946	112,964	-	420,958	533,922					
1947	139,395	-	491,229	630,624					
1948	139,506	-	460,012	599,518					
1949	106,045	-	331,823	437,868					

[e]Estimated.

Though the coal industry may be classified as extremely labor intensive, it is also capital intensive. Coal-mining technology has been changing during the past few years. Today's coal mines demand costly mining and transportation equipment. Also, additional and expensive special machinery must be installed to meet regulatory standards of health, safety, and environment. All of these require enormous amounts of capital and long leadtimes for mine development and expansion. The National Academy of Engineering in its recent study, called "United States Energy Prospects--1974," estimates a capital need of $21 billion (1974) to double coal production capacity from the current level of about 600 million tons to 1.2 billion tons per year.

OVERVIEW OF U.S. BITUMINOUS COAL INDUSTRY

Basic Information

Coal is a soft black or brown rock of many uses (heating homes and buildings, and making iron and steel and hundreds of chemical products such as aspirin, nylon, dyes, etc.). It helped make the United States the leading industrial nation of the world. Coal occurs in four principal rocks: lignite, subbituminous, bituminous, and anthracite.

This study addresses bituminous coal exclusively because of its economic utility. Also, it is now generally recognized as the only domestic fuel readily available in sufficient quantity to fill the widening gap in the Nation's energy needs and contribute as a key element in the success of Project Independence.

Bituminous coal, on a commercial basis, is classified into two general grades--steam coal and metallurgical coal.

Steam Coal

The most important market for steam coal is the electric utility industry, which consumes more than 65 percent of all coal produced in the United States. Steam coal is supplied by strip and underground mines and is generally of lower grade than metallurgical coal.

Metallurgical or Coking Coal

The steel industry is the next largest market for bituminous coal. Metallurgical coal is used to produce coke, an essential ingredient in the production of pig iron. It is one of the basic raw materials of the steel industry and is perhaps more important to the steelmaker than steam coal is to the electric utility because no substitute has been found so far to extract metallic iron from its ores in blast furnaces in a rapid and efficient manner. Coking coal is mined underground.

Bituminous Coal Supply

The United States has an abundance of coal. But, there is no single answer as to how much coal the United States has. The U.S. Geological Survey

has identified coal resources of 1.7 trillion tons, enough for more than 2,500 years at the current rate of production--about 600 million tons per year--but much of this coal cannot be recovered economically. A more realistic estimate of the demonstrated coal reserve base is 437 billion tons, of which it is estimated that with current technology and in the light of economics, about a 365-year supply would be available at the current rate of annual production.[4]

Though coal is generally recognized as the only fuel available in sufficient quantity and low enough in price to fill the emerging energy needs, the industry is extremely labor intensive. Accordingly, one of the most important factors for coal supply is labor. It is one of the key ingredients to coal's future.

Impact of Coal On U.S. Economy

Nearly all U.S. industries are likely to be affected seriously if there are any interruptions in the steady flow of coal from mines; for example, the steel industry, which depends on coke, and automobile plants, shipyards, and hundreds of other manufacturing industries, which depend on steel. Also, without coal, energy may not be provided to generate electricity; essential community services may be cut off. Thus, the normal operation of the coal mining industry is vital to the Nation's economy.

Accordingly, the coal industry, from time to time, has been subject to Government regulation; for example, during World War I, World War II, and the Korean war. The National Industrial Recovery Act of 1933 and the Coal Conservation Act of 1935 (both declared unconstitutional) and the Bituminous Coal Act of 1937 instituted minimum coal prices and aided in negotiation of wage-hour agreements until the expiration of the latter act in 1943. The National Bituminous Coal Commission, established by the Bituminous Coal Act, generated many appeals owing to minimum coal prices and the Commission was abolished in July 1, 1939. During World War II (April 1943), the Solid Fuels Administration for War was established to manage coal distribution, and the Office of Price Administration set the maximum prices for solid fuels. The industry was regulated in the early 1970's under the Economic Stabilization Program, but prices were decontrolled on March 27, 1974. During periods of national emergency, such as during World War II (May 1, 1943-October 13, 1943), the Government has operated the coal mines when labor-management disputes threatened coal production.

Competition--Adverse and Propitious

The coal-mining companies' debt structure acceptability depends ultimately upon income cash flows. These, in turn, depend upon prices and operating expenses in which the former is expected to exceed the latter by a margin

[4]U.S. Geological Survey. Coal Resources of the United States, January 1, 1974. Bull. 1412, 1975, 131 pp.; also, U.S. Bureau of Mines. Demonstrated Coal Reserve Base of the United States, by Sulfur Category on January 1, 1974. Mineral Industry Survey, May 1975, 7 pp.

large enough to satisfy both contractual debt and equity. Coal prices must be at least at such level for the coal industry to provide adequate rates of return on investment to generate new capital internally and externally.

The prices of coal has followed rather closely trends in business activity. The average coal price per ton is a weighted average price reflecting a variety of types and grades of coal and a variety of production costs. During the early 1950's, coal prices were steady, then from a sharp drop in 1954, prices rose from 1955 to 1957, weakened from 1958 to 1963, and rose again from 1963 to 1975. It is estimated that about 85 percent of all coal mined is sold domestically or exported under long-term contracts (5 to 30 years) with provisions for cost pass-through (for changes in mining costs), or captively produced, leaving approximately 15 percent on the free, spot market.

From the 1950's until recently, petroleum and natural gas were adversely affecting coal demand because they were cheaper, cleaner, and more convenient fuels. Coal prices were affected for years by competition from easily available low-cost residual fuel oil from foreign sources, and from artificially low natural gas prices. Hence, petroleum and natural gas became an economical substitute for coal. By the 1960's, the desires for cleaner environments brought pressures against the use of coal because coal-burning powerplants typically emitted large amounts of particulate matter. Moreover, the general run of coals has a high sulfur content, and powerplants are major sources of sulfur dioxide emissions. Prior to the passage of Federal environmental protection laws, many localities enacted ordinances that made continued use of coal impossible. During this initial period, the Federal Government encouraged the conversion of many coal-fired plants to oil and the retirement of old, inefficient coal-burning facilities.

Ironically, petroleum and natural gas were the major competitors of coal during the past 15 to 20 years, but now they are the primary support of the present coal price structure. Consequently, the coal market is now distorted and its price need no longer be related to production costs but rather to its commodity value. One ton of coal has roughly the same energy content as four barrels of oil, and when oil sells at $5.25 to $11.50 per barrel, depending on whether it is domestic or new oil or foreign oil, a coal price of between $25 and $40 per ton would not be far out of line.

Accordingly, OPEC actions should influence the price of coal, which is expected to follow the oil prices. As long as this influence continues, it should help coal companies generate needed capital internally through cash flow in spite of the related increased cost of operation.

U.S. Coal Consumption by Usage

Coal was the Nation's dominant energy source at the turn of the century. The energy economy of the United States depended almost completely upon coal (more than 70 percent in 1900). Coal consumption reached an alltime high during 1943 and 1944, 594 million and 590 million tons, respectively. At that time, coal was providing about 50 percent of the Nation's total energy supply.

Since the war period, the usage of coal declined rapidly except in metallurgy and in power generation in electric plants. Petroleum and natural gas displaced coal as a power source in transportation (including railroads) and as heating fuel for homes and industry. Today, petroleum and natural gas provide about 76 percent of the Nation's energy needs; coal provides less than 20 percent.[5]

It was not until the early 1960's that coal usage began to increase, almost all due to expansion in electric utility service demand, which was growing at the rate of doubling every decade. Utility coal consumption has grown at the annual rate of 5.9 percent over the past decade from 209 million tons in 1963 to 388 million tons in 1974, while industrial and home heating demand declined and metallurgical usage remained relatively constant. However, the total U.S. coal consumption and exports increased at an annual rate of 2.7 percent and 3.6 percent, respectively, for the like period (table 2).

As a result of the realization of the developing domestic shortage of oil and natural gas, problems of nuclear energy, an accelerating search for alternative sources of energy, and the Government's drive for increased domestic supplies of energy, coal has become an area of national focus. Demand for coal, especially for steam and metallurgical coals, are expected to increase rapidly through a combination of growth in the economy and Government fiat. An example of the latter is the recent Federal Energy Administration (FEA) Prohibition Order[6] compelling 20 or more electric utilities to convert their generating plants from oil and natural gas to coal and requiring certain proposed new powerplants to be built with coal-burning capacity, as part of an effort to curtail use of imported crude.

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[5]U.S. Department of the Interior. 1975 Annual Report of the Secretary of the Interior. 1975, p. 8.

[6]Federal Register. V. 40-129, July 3, 1975, pp. 28430-28436.

TABLE 2. - Bituminous coal consumption in the United States, by major usage and exports, million tons

Year	Electric utilities	Railroads (class 1)	Coking coal	All other industrial	Retail deliveries	Total U.S. consumption	Exports
1940	49.1	85.1	81.4	130.6	84.7	430.9	16.5
1941	59.9	97.4	93.1	147.3	94.4	492.1	20.7
1942	63.5	115.4	100.9	158.2	102.1	540.1	22.9
1943	74.0	130.3	102.5	166.9	120.1	593.8	25.8
1944	76.7	132.0	105.3	153.5	122.1	589.6	26.0
1950	88.3	61.0	103.8	116.7	84.4	454.2	25.2
1951	101.9	54.0	113.4	125.2	74.4	468.9	56.7
1952	103.3	38.0	97.6	113.0	66.9	418.8	47.6
1953	112.3	27.7	112.9	113.9	60.0	426.8	33.8
1954	115.2	17.4	85.4	93.3	51.8	363.1	31.0
1960	173.9	2.1	81.0	93.0	30.4	380.4	36.5
1961	179.6	([1])	73.9	93.2	27.7	374.4	35.0
1962	190.8	([1])	74.3	94.5	28.2	387.8	38.4
1963	209.0	([1])	77.6	99.0	23.6	409.2	47.1
1964	223.0	([1])	88.8	99.7	19.6	431.1	48.0
1965	242.7	([1])	94.8	102.0	19.0	459.2	50.2
1966	264.2	([1])	95.9	105.5	20.0	486.3	49.3
1967	271.8	([1])	92.1	98.8	17.1	480.4	49.5
1968	294.7	([1])	90.7	97.7	15.2	498.8	50.6
1969	308.5	([1])	92.9	91.0	14.7	507.3	56.2
1970	318.9	([1])	96.0	88.3	12.1	515.6	70.9
1971	326.3	([1])	82.8	74.3	11.4	494.9	56.6
1972	348.6	([1])	87.3	72.0	8.7	516.8	56.0
1973	386.9	([1])	93.6	67.2	8.2	556.0	52.9
1974	390.1	([1])	89.7	64.1	8.8	552.7	59.9

[1]Included in "All other industrial."

CORPORATE STRUCTURE AND BEHAVIOR

Like any other U.S. enterprises, coal producers generally started as small companies, many as family businesses. The industry was extremely labor intensive. Until recently, except during World War II and a few years thereafter, coal has faced vigorous competition from previously abundant, more convenient, artificially cheap supplies of natural gas and oil. In the early 1960's, the future of the coal markets appeared to be clearly limited by the supposedly limitless promises of nuclear energy. Accordingly, the industry, which was extremely fragmented with about 5,000 companies (few large and many small) made little capital investment in new mines, expansion and improvement of existing mines, or purchase of new machinery.

Financial and Corporate Interconnections

During the 1960's, radical changes were being initiated in the corporate structure of business. It was common practice for companies to become

involved in conglomerates, mergers, and diversifications. The coal industry was no exception to this trend. Despite its sagging profits, other resource-based companies, especially major oil companies, saw a future potential in the financially troubled coal companies. These major oil companies moved to purchase coal producers and acquired coal reserves through outright purchase and lease. They apparently foresaw the limitations of oil and gas production in meeting the Nation's soaring energy demands and looked ahead to converting coal to synthetic natural gas and liquid petroleum.

Most of the large coal producers (annual production of more than 3 million tons) became subsidiaries or affiliates of major oil companies or other mineral resource producers. In fact, today's big coal producers are in most cases not just coal companies per se. Instead, they are subsidiaries or divisions of some of the largest oil, metal, steel, and utility corporations in the world, with strong capital and corporate structures. (See table 3.) It is important to note that nearly all of the top 15 coal producers are in this category. Companies' 10K, U5S (holding), and other financial data are the bases for this analysis.

Directors and Officers Interconnections--Holding Company and Parent-Subsidiary

In addition to the foregoing macroeconomic industry transformation, the size (annual tonnage) and the number of coal producers were also changing (table 4). The trend toward fewer but larger companies continues each year. The Keystone Coal Industry Manual shows about 3,900 companies (parent), including subsidiaries, and 597 of these are responsible for 94.5 percent of the national coal production. Also, there are 3,303 companies each producing less than 100,000 tons of coal per year, or about 8,000 tons per month. They represent approximately 5.5 percent of the national total. Though the number of small companies has increased slightly in 1974, reversing the trend of the past several years, their share of the total production has dropped from 17.8 percent in 1949 to 5.5 percent in 1974 (table 5). The number of small companies will no doubt continue to decline owing to increased cost of operations and difficulties in attracting new capital for mine improvement and expansion, purchase of mining equipment, and opening of new mines. The long leadtime for completion, coupled with the full impact of expenses of the 1969 Coal Mine Health and Safety Act, compounds this difficulty. Moreover, many of the natural resource-based companies have accelerated their acquisition program of coal reserves and small producers. For example, during 1974, A. T. Massey Coal Co. was acquired by St. Joe Minerals Corp., and Ziegler Coal Co. was acquired by Houston Natural Gas Co.; Texaco Inc. agreed to purchase coal reserves in Wyoming from Reynolds Metals Co. Kerr McGee Corp. has formed a subsidiary, Kerr McGee Coal Co.; Exxon Corp., through its operating affiliate Carter Oil Co., with its wholly owned subsidiary Monterey Coal Co., has embarked upon a vigorous expansion program at its coal mine at Carlinville, Ill. The company is increasing its production to 3 million tons per year to supply an electric power company serving the Chicago area.

TABLE 3.- Industry affiliations of selected coal-producing groups in 1974

Coal-producing group, subsidiary or division	Parent or controlling company	1974 coal output, million tons	Percent of industry total	Industry affiliations, percent of total industry 1974 output					
				Coal	Petroleum	Metal	Steel	Utilities	Other
Peabody	Kennecott Copper Corp[1]	70.7	11.8	-	-	11.8	-	-	-
Consolidation	Continental Oil Co	47.1	8.0	-	8.0	-	-	-	-
Island Creek and Maust	Occidental Petroleum Corp	22.8	3.8	-	3.8	-	-	-	-
Amax Coal	Amax Inc	19.9	3.3	-	-	3.3	-	-	-
Clinchfield Coal	Pittston Co.[2]	18.9	3.1	3.1	-	-	-	-	-
Captive	United States Steel Corp	16.4	2.7	-	-	-	2.7	-	-
Arch	Ashland Oil Inc	14.3	2.4	-	2.4	-	-	-	-
Captive	Bethlehem Steel Corp	13.9	2.3	-	-	-	2.3	-	-
Westmoreland	Westmoreland Coal Co	13.2	2.2	2.2	-	-	-	-	-
A. T. Massey Coal Co	St. Joe Minerals Corp	12.8	2.1	-	-	2.1	-	-	-
North American Coal	North American Coal Co	11.3	1.9	1.9	-	-	-	-	-
Eastern Associated Coal	Eastern Gas and Fuel Associates[2]	10.4	1.7	1.7	-	-	-	-	-
Old Ben	Standard Oil Co. (Ohio)	9.5	1.6	-	1.6	-	-	-	-
Pittsburgh and Midway	Gulf Oil Co	7.5	1.3	-	1.3	-	-	-	-
Navajo and San Juan	Utah International Inc	7.1	1.2	-	-	1.2	-	-	-
Freeman and United Electric	General Dynamics Corp	7.0	1.2	-	-	-	-	-	1.2
Captive (7 units)	American Electric Power Co.[3]	6.7	1.1	-	-	-	-	1.1	-
Joint Venture	Pacific Power and Light Co	6.5	1.1	-	-	-	-	1.1	-
Valley Camp	Valley Camp Coal Co	6.2	1.0	1.0	-	-	-	-	-
Pittsburgh and West Virginia	Industrial Fuels Corp	5.7	1.0	1.0	-	-	-	-	-
Rochester and Pittsburgh	Rochester and Pittsburgh Coal Co	4.6	.8	.8	-	-	-	-	-
Ziegler	Houston Natural Gas Corp	4.5	.8	-	.8	-	-	-	-
Falcon Coal	Falcon Seaboard Co	3.4	.6	-	-	-	-	-	.6
C&K	Gulf Resources and Chemical Co	3.2	.5	-	-	.5	-	-	-
Captive	Alabama By-Products Corp	3.1	.5	.5	-	-	-	-	-
Carbon Fuel	Carbon Industries Inc.[2]	2.8	.5	.5	-	-	-	-	-
Rapoca	Rapoca Energy Corp	1.8	.3	.3	-	-	-	-	-
Westrans	Westrans Industries Inc	1.4	.2	.2	-	-	-	-	-
Appalachian	Appalachian Resource Co	.8	.1	.1	-	-	-	-	-
Diamond Coal	Transcontinental Oil Corp	.8	.1	.1	-	-	-	-	-
Total[3]	-	354.3	59.2	13.4	17.9	18.9	5.0	2.2	1.8

[1]Subject to Government Divesture Order. Request for reconsideration submitted.
[2]Holding company.
[3]Industry total = 603.4 million tons.

Source: 10K and U5S (Securities and Exchange Commission) of the companies listed and other related financial information. Industry affiliation based on primary line of business.

TABLE 4. - Number of coal companies in 1974, by size and production

Size class	Number of companies	Production, thousand tons	Percent of total production
3,000,000 tons and over.....	31	347,437	57.8
1,000,000-2,999,999 tons.....	42	78,489	13.0
500,000-999,999 tons.....	59	40,740	6.8
100,000-499,999 tons.....	465	101,759	16.9
Less than 100,000 tons.....	[e]3,303	32,575	5.5
Total.....	3,900	[p]601,000	100.0

[e]Estimated. [p]Preliminary.

Source: Keystone Coal Industry Manual.

TABLE 5. - Percentages of coal output by tonnage class, 1949-74

Tonnage range	1949	1960	1965	1970	1971	1972	1973	1974
1,000,000 tons and over.....	50.5	64.9	68.1	72.3	70.3	74.6	76.0	70.8
100,000-999,999 tons.....	31.7	22.1	22.5	21.5	24.2	20.3	20.9	23.7
Under 100,000 tons.....	17.8	13.0	9.4	6.2	5.5	5.1	3.1	5.5
Total.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total, million tons....	438	415	512	603	552	595	592	[p]601

[p]Preliminary.

Sources: Keystone Coal Industry Manual
U.S. Bureau of Mines, Division of Coal.

The companies with captive mines--that is, coal is utilized within the companies as one of the inputs for the end product (such as steel, chemical, and electric utility industries)--have become extremely active in their purchase of small coal companies and coal reserves.

American Electric Power Co., Inc., is one example. It has a corporate status as a utility holding company (a status that allows it to enter other lines of business) and is one of the top 17 coal producers. More than 93 percent of its generating capacity is coal fired. Through its subsidiaries, the company produces about 21 percent of the coal it consumes. Through its existing and new subsidiaries, it plans to increase this percentage to about 50 percent by 1980 by acquiring small producing companies and proven coal reserves and by expanding production from existing mines. This pattern is also being followed by the steel industry. Bethlehem Steel Co. recently purchased a coal mine from Union Carbide to lessen its outside dependence for metallurgical coal. Also, foreign companies, such as the French and West German steel companies, have already bought into or made tender offers to small West Virginia coal producers.

This trend toward fewer and larger companies being in turn absorbed by mineral and energy companies should strengthen coal's financial structure and aids its position in the new capital market. A parent or controlling company with a coal subsidiary or affiliate can readily shift capital funds in accordance with program needs. Also, an organization of this nature can more easily

approach the money market for new capital as contrasted with the difficulty the average coal company might have.

The intricate corporate structure, which interfaces with financial institutions through interconnecting directorships, provides access to financial markets and facilitates arrangement for financial leverage and allocation of funds to meet short- to long-range capital requirements. These methodologies are illustrated in figures 2 and 3 and in table 6, which show stylized examples of coal and electric power subsidiaries under a holding company, the interconnections of officers and directors in the organizations, and the interconnections of directors with various financial institutions (figs. 2-3; table 6).

Project or Consortium Financing

Another way to attract new capital is joint ventures. A mining or a resource-based company agrees with one or more electric utilities to jointly develop a coal mining facility. This approach usually means setting up a mining entity, including coal-supply agreements with participating electric utilities (project financing). This type of venture reduces the total capital requirement of any one company, and the attendant risk is minimized. This capital financing is depicted in figure 4.

Some utility companies have insured their coal supplies by purchasing or agreeing to buy preferred indebtedness of a coal mining company whose parent firm is a subsidiary of a large multinational mineral-resource corporation. Under this system, the utility company does not have any managing control but assures itself a direct interest in the coal reserve plus a return on its debt instrument.

Other Financing Alternatives

Other lesser utilized external financing, not in the category of "straight-up" indebtedness, includes (1) subordinated long-term debt, which ranks behind the senior creditors, (2) "capitalized lease obligations," which may represent lease of plants or transportation equipment (considered debt financing), and (3) production payments (sometimes known as off-balance-sheet financing). A production payment is a sale of conveyance of minerals in the ground to another party; repayment is made out of future minerals if, as, and when produced. Kennecott Copper Co. applied this method of financing to acquire Peabody Coal Co.

TABLE 6. - Interconnections of officers and directors, the holding company, and subsidiaries

Dfficers and directors \ Company and subsidiaries	Utility (holding company)	Ae service corporation	Be power company	De coal company	Ee coal company	Fe coal company	Ge power company	He operating company	Ke power company	Ce power company	Ie electric company	Je power company	Le power company	Me exploration company	Oe electric company	Pf power company	Rf power company	Cf operating company	Af electric company	Df coal company	Ef coal company	Ze coal company	Re electric corporation	Ve electric corporation	Se electric company	Te rail company	Ue estate company	Ve estate company	Xe manufacturing incorporated	We power company
A.....	CB CED	CB CED	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	-	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P	D-P
B.....	D-VCB	D-VCB	D-VP	D	-	-	D	-	-	D-VP	-	-	D-VP	D-VP		D-VP	D	-	-D-VP	D	D	-	-	-	-	D-VP	D-VP	VP	-	D-VP
C.....	D-P	D-P	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	-	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D	-	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP
D.....	D-VP	D-SVP	D	-	-	-	D	-	D	D	-	D	-	-	-	-	-	-	-	-	-	-	-	-	D	D	D	D	-	-
E.....	T	D-T	D-T	D-T	D-T	D-T	T	T	T	T	D-T	D-T	T	T	-	D-T	T	T	D-T	D-T	D-T	D-T	-	-	D-T	D-T	T	T	T	D-T
F.....	D	D SEVP	D-VP	D	-	-	-	-	-	D-VP	V-P	D-VP	-	-	-	D-VP	-	-	D-VP	-	-	-	-	-	D-VP	-	-	-	-	D-VP
G.....	D	D SEVP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	-	-	D-VP	-	D	-	D-VP	D-VP	D-VP	-	-	D-VP	-	V-P	-	-	-
H.....	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I.....	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J.....	-	D-VP	-	-	-	-	-	-	-	-	-	-	-	D-S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K.....	-	D-SVP	D	-	-	-	-	-	D	-	-	D	-	-	D	-	-	-	-	-	-	-	-	D	D	-	-	-	-	-
L.....	-	D	-	-	-	-	-	-	-	-	-	-	-	-	D-VP	-	-	V-P	-	-	-	-	-	-	-	VP	-	-	-	-
M.....	-	D	-	-	D-VP	-	-	D-VP	-	-	-	-	-	-	D-EVP	V-P	D-VP	D-EVP	D-VP	D-VP	D-VP	D	-	-	-	VP	-	-	-	-
N.....	-	D-VP	S	D-S	S	D-S	S	S	D-S	S	S	S	S	-	S	S	S	S	S	D-S	D-S	-	-	S	S	D-S	D-S	S	S	-
D.....	-	D	-	-	-	-	-	-	-	D-VP	-	D-EVP	D-VP	-	-	-	--	-	-	-	-	-	-	-	-	V-P	-	-	-	-
P.....	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D-EVP	-	V-P	-	-	-	-
Q.....	-	D	D-EVP	D-VP	D-VP	D-VP	D-VP	D-VP	D-VP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	V-P	-	-	-	-
R.....	-	D	-	-	-	-	-	-	-	-	-	-	-	D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.....	-	D	-	-	-	-	-	-	-	-	-	-	-	D-P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T.....	-	D	-	-	-	-	-	D	-	-	-	-	-	-	-	D-VC	-	-	-	-	-	-	-	-	-	-	-	-	-	-

CB-Chairman of board
CED-Chief executive officer
VCB-Vice chairman of board

P-President
SEVP-Senior executive vice president
EVP-Executive vice president

SVP-Senior vice president
VP-Vice president
S-Secretary

T-Tressurer
D-Director

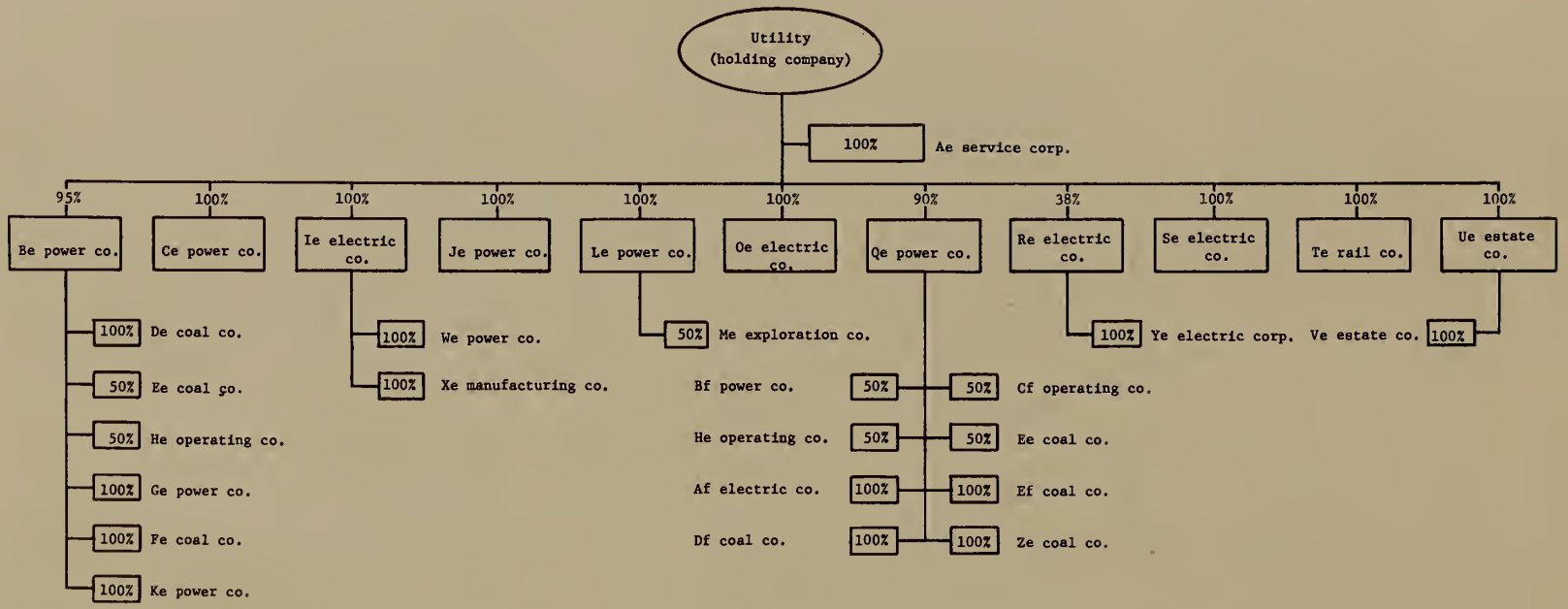

FIGURE 2. - Example of structure of financial interconnections between holding company and subsidiaries.

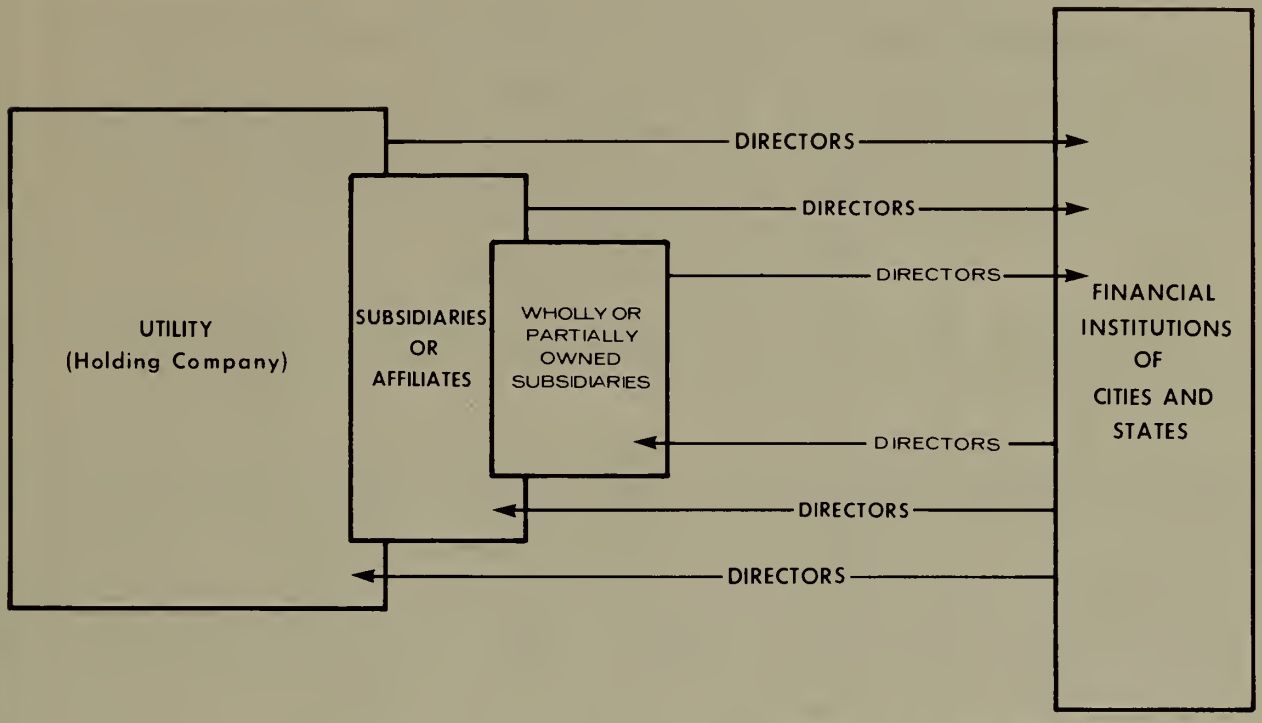

FIGURE 3. - Example of interconnected financial directorships for some companies.

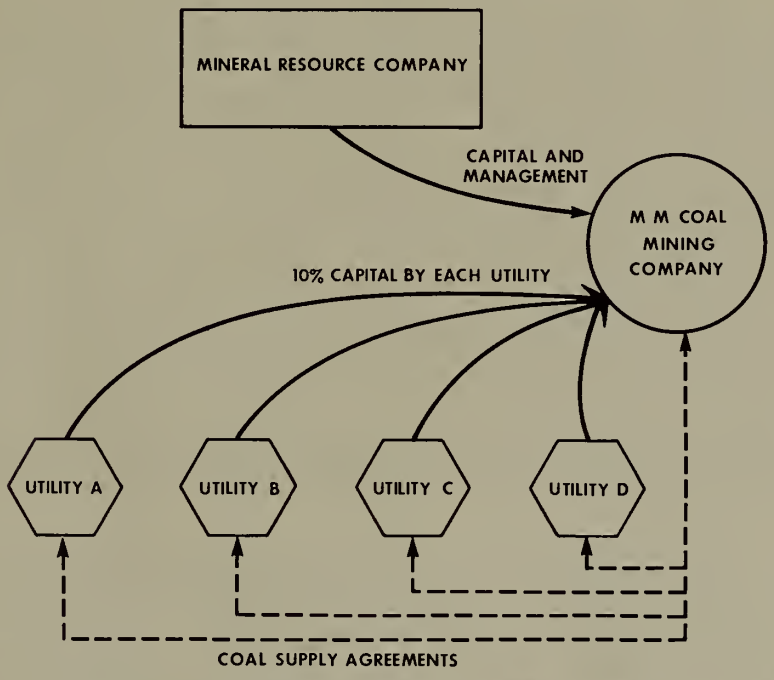

FIGURE 4. - Example of interconnected consortium structure financing for some companies.

FINANCIAL ANALYSIS AND ASSESSMENT--SELECTED COAL PRODUCERS

The 30 selected coal firms listed in table 7 include the 20 top coal producers and 10 others of medium to small size, responsible for about 60 percent of the Nation's 1974 coal production. The analysis covers the 6-year period from 1969 to 1974 for each of the selected companies.

Methodology and Approaches

Table 7 lists the first 20 coal-producing companies in order of their impact on the Nation's 1974 total production; the other 10 companies are included for the purpose of comparison.

There are many kinds of quantitative analyses and means of comparison to measure the financial strength of a company and its success in operations. Company profitability (bottom-line) is the choice for this study because of its impact on the generation of capital, both internally (earnings plus non-fund charges) and externally (public and special money market). The profitability impact is reflected in the rates of return on the average shareholder's equity and on the average total invested capital. Table 7 does not permit direct calculation of the latter item because the interest costs on long-term indebtedness are not excluded in the determination of net income.

Coal Industry Concentration

In the coal industry, the two largest firms (Peabody and Consolidation) accounted for more than 20 percent of all sales. Except for those companies whose primary product is coal, revenues from coal are greater than 20 percent of total corporate revenues in only three cases. Furthermore, of the 15 leading producers, two firms produce coal for their own use ("captive" coal). Of the six petroleum companies listed, the sum of their sales equals about 17.9 percent of the national total, but in no case did coal business account for more than 11 percent of individual oil company sales. One leading producer includes in its sale coal mined for the Tennessee Valley Authority (TVA) under contract of TVA-owned coal reserve (about 4.4 million tons per year), and coal produced by other small firms and independent contractors (brokerage coal). Many large coal companies buy and sell the coal of other producers. Therefore, the coal sales of the firms are beyond their own production sales. Further, the industry identification of an oil company may be inappropriate because the composition of the firm is changing gradually, and its principal business may not be oil.

Of the 30 listed companies, 15 are neither independent coal (primary) producers nor operators of captive mines (coal mined for its own use). Significantly, only one of the 15 (not independent nor with captive mines) derives more than 27 percent of its sales from coal. For other major energy resource companies, coal accounted for less than 15 percent of sales. Thus, their attraction for new capital would be heavily influenced by factors other than coal.

TABLE 7. - Financial analysis of selected U.S. coal-producing companies

Year	Coal output (sold)		Revenues, millions		Coal as percent	Coal net income,	Net profit,	Average shareholders	Average invested	Return on average, percent		Coal capital
	Million short tons	Percent of industry total	Total	Coal	of total sales	millions	millions	equity, millions	capital, millions	Shareholders equity	Invested capital	expenditures, millions
KENNECOTT COPPER CORP.												
1974..	[1]70.7	11.8	$1,664.2	$504.1	30.3	$23.5	$210.9	$1,374.6	$1,844.0	15.3	13.4	$110.8
1973..	72.0	12.2	1,395.1	381.3	27.3	-3.6	159.4	1,255.5	1,711.7	12.7	11.1	117.3
1972..	77.2	13.0	1,145.3	344.4	30.1	10.2	47.4	1,196.2	1,676.4	4.0	4.5	121.0
1971..	63.1	11.4	1,053.4	268.8	25.5	10.2	85.0	1,174.5	1,606.6	7.2	7.1	103.9
1970..	74.3	12.3	1,133.1	283.5	25.0	20.9	149.9	1,128.6	1,481.9	13.3	11.9	57.8
1969..	[e]69.5	12.4	1,050.0	260.7	24.8	23.3	164.7	1,054.3	1,405.8	15.6	13.6	107.9
CONTINENTAL OIL CO.												
1974..	47.1	8.0	7,365.2	747.0	10.1	43.8	327.6	1,931.4	3,139.7	17.0	13.9	141.1
1973..	54.4	9.2	4,509.6	473.7	10.5	-12.8	242.7	1,724.2	2,775.9	14.1	11.8	69.0
1972..	58.5	9.8	3,689.1	421.0	11.4	16.6	170.2	1,588.1	2,589.9	10.7	9.3	76.5
1971..	49.0	8.9	3,146.2	320.9	10.2	7.6	109.4	1,518.9	2,500.6	7.2	7.1	74.5
1970..	57.4	9.5	2,812.6	312.3	11.1	21.3	160.2	1,499.1	2,456.3	10.7	9.0	76.3
1969..	53.6	9.6	2,451.7	244.7	10.0	18.2	154.9	1,456.6	2,276.9	10.6	9.1	68.4
OCCIDENTAL PETROLEUM CORP.												
1974..	22.8	3.8	5,537.5	561.4	10.0	131.1	280.7	970.6	2,315.2	28.9	16.4	31.1
1973..	24.6	4.2	3,013.8	301.1	10.0	15.8	71.9	838.7	2,099.7	8.6	8.1	18.0
1972..	24.6	4.1	2,382.5	255.2	11.0	8.3	2.9	835.0	2,076.4	.1	3.8	38.9
1971..	25.4	4.6	2,280.3	247.2	11.0	4.4	-73.9	906.6	2,048.0	-7.5	-.3	61.0
1970..	31.9	5.3	2,129.3	262.2	13.0	29.7	169.6	916.8	1,909.0	18.5	11.7	55.0
1969..	31.5	5.6	2,059.1	192.5	9.4	20.7	174.1	808.8	1,625.5	21.5	13.2	62.0
AMAX INC.												
1974..	19.9	3.3	1,163.4	139.6	12.0	[a]45.0	139.1	891.3	1,514.2	15.6	11.8	[a]89.0
1973..	16.6	2.8	1,336.8	93.6	7.0	[a]22.0	105.1	766.7	1,387.0	13.7	9.5	[a]64.0
1972..	16.3	2.7	876.4	87.6	10.2	[a]23.0	66.2	659.6	1,224.9	10.0	7.1	[a]52.0
1971..	12.5	2.3	767.4	61.4	8.1	[a]15.0	51.3	618.0	1,052.0	8.3	7.3	[a]36.0
1970..	14.3	2.4	858.6	60.1	7.2	[a]13.0	72.6	581.4	891.8	12.5	10.4	[a]19.0
1969..	([3])	-	753.5	-	-	-	82.0	504.2	754.8	16.3	12.3	[a]76.0
PITTSTON CO. (HOLDING)												
1974..	18.9	3.1	1,154.7	577.4	50.0	100.0	107.5	276.4	438.2	38.9	26.4	40.0
1973..	20.7	3.5	689.6	303.4	44.0	16.0	15.3	228.7	403.6	6.7	6.1	30.0
1972..	22.9	3.9	627.4	288.6	46.0	12.8	28.6	217.9	379.6	13.1	10.0	[e]30.0
1971..	21.7	3.9	583.2	256.6	44.0	19.8	43.4	191.0	326.9	22.7	15.6	[e]41.0
1970..	22.3	3.7	507.9	223.5	44.0	23.5	39.4	157.6	293.9	25.0	16.0	[e]75.0
1969..	21.5	3.8	420.3	151.3	36.0	9.5	17.2	135.5	255.8	12.7	9.0	20.3
UNITED STATES STEEL CORP.												
1974..	16.4	2.7	9,337.6	NAp	NAp	NAp	634.9	4,196.4	5,781.7	15.1	12.6	NA
1973..	16.3	2.8	7,044.7	NAp	NAp	NAp	325.8	3,694.0	5,457.1	8.8	7.7	NA
1972..	16.5	2.8	5,443.4	NAp	NAp	NAp	157.0	3,542.0	5,348.2	4.4	4.5	NA
1971..	16.6	3.0	4,966.7	NAp	NAp	NAp	154.5	3,478.6	5,293.5	4.4	4.4	NA
1970..	19.6	3.3	4,893.0	NAp	NAp	NAp	147.5	3,441.4	5,267.9	4.3	4.3	NA
1969..	18.1	3.2	4,834.6	NAp	NAp	NAp	217.2	3,388.6	5,268.4	6.4	5.6	NA
ASHLAND OIL INC.[4]												
1974..	14.3	2.4	3,502.3	[e]92.1	2.6	[5]4.8	113.0	600.8	1,186.4	18.8	12.0	23.5
1973..	[6]12.0	2.0	2,327.4	[e]55.8	2.4	[5]-.3	84.3	523.5	1,061.5	16.1	10.3	[5]2.5
1972..	5.8	1.0	2,029.5	NA	NA	[5].5	67.8	471.8	925.7	14.4	9.5	[6]3.5
1971..	1.9	.3	1,848.3	NA	NA	[6]-.1	23.7	443.2	827.4	5.4	5.3	[6].9
1970..	([7])	-	1,627.4	-	-	[6]-.6	37.8	431.1	784.8	8.8	7.1	[6].5
1969..	-	-	1,440.3	-	-	-	56.4	394.4	686.6	14.3	10.2	[6]2.9
BETHLEHEM STEEL CORP.												
1974..	13.9	2.3	5,448.7	NAp	NAp	NAp	342.0	2,366.2	3,351.5	14.5	11.5	NA
1973..	14.1	2.4	4,178.9	NAp	NAp	NAp	206.6	2,189.5	3,133.2	9.4	7.8	NA
1972..	13.3	2.2	3,140.2	NAp	NAp	NAp	134.6	2,096.2	3,027.4	6.4	5.7	NA
1971..	12.0	2.2	3,001.6	NAp	NAp	NAp	139.2	2,009.7	2,782.1	6.9	6.3	NA
1970..	14.6	2.4	2,964.2	NAp	NAp	NAp	90.1	1,964.0	2,657.0	4.6	4.6	NA
1969..	13.0	2.3	2,956.2	NAp	NAp	NAp	156.5	1,924.1	2,483.3	8.1	7.2	NA
WESTMORELAND COAL CO.												
1974..	13.2	2.2	420.0	399.0	95.0	45.0	36.2	82.6	107.3	43.8	35.6	20.4
1973..	13.0	2.2	185.8	173.5	93.4	2.9	4.7	65.3	89.7	7.2	5.9	18.0
1972..	13.2	2.2	169.3	160.0	94.5	5.1	4.4	63.5	74.7	6.9	6.0	22.7
1971..	13.1	2.4	153.2	144.8	94.5	4.9	4.4	61.8	71.3	7.1	6.4	16.6
1970..	18.2	3.0	176.5	164.8	93.4	11.3	10.7	48.4	65.4	22.1	18.2	7.6
1969..	16.9	3.0	118.3	107.7	91.0	.8	1.6	35.9	54.4	4.5	5.0	15.2
ST. JOE MINERALS CORP.[8]												
1974..	12.8	2.1	687.7	332.8	48.4	31.8	88.6	264.2	352.5	33.5	26.3	31.5
1973..	12.4	2.1	399.2	144.8	36.3	6.4	37.8	217.3	289.3	17.4	14.3	12.8
1972..	12.1	2.0	321.3	116.2	36.2	1.8	27.3	198.0	238.6	13.8	12.6	15.2
1971..	10.9	2.0	280.6	118.4	42.2	4.5	24.0	185.6	212.1	13.0	11.9	12.0
1970..	15.2	2.5	313.7	152.7	48.7	7.5	33.7	170.2	196.4	19.6	17.3	-
NORTH AMERICAN COAL CORP.												
1974..	11.3	1.9	161.4	161.4	100.0	4.9	4.9	36.0	182.5	13.7	10.4	17.4
1973..	12.4	2.1	125.2	125.2	100.0	4.5	4.5	32.4	168.7	13.9	8.2	23.8
1972..	12.0	2.0	100.0	100.0	100.0	2.6	2.6	29.7	145.8	8.9	6.9	37.0
1971..	9.2	1.7	63.6	63.6	100.0	1.3	1.3	28.6	106.6	4.6	5.9	38.6
1970..	10.0	1.7	56.5	56.5	100.0	1.9	1.9	28.0	77.6	6.8	6.6	21.4
1969..	9.3	1.7	44.5	44.5	100.0	1.3	1.3	27.3	61.6	4.8	5.5	13.9
EASTERN GAS AND FUEL ASSOCIATES (EASTERN ASSOCIATES COAL ONLY)												
1974..	10.4	1.7	281.9	256.5	91.0	31.4	34.1	90.7	183.4	37.6	19.8	23.4
1973..	12.1	2.1	161.4	145.2	90.0	-2.4	-.3	77.1	165.0	-.4	1.8	3.4
1972..	14.4	2.4	169.7	157.8	93.0	3.6	4.8	84.9	152.7	5.7	4.7	5.3
1971..	14.4	2.6	162.4	149.4	92.0	9.3	11.4	86.7	136.9	13.2	10.2	12.1
1970..	20.0	3.3	184.0	173.0	94.0	20.5	22.3	70.6	124.9	31.6	19.6	8.9
1969..	18.6	3.3	120.3	113.1	94.0	3.4	4.7	57.8	120.3	8.4	5.1	10.4

See footnotes at end of table

TABLE 7. - Financial analysis of selected U.S. coal-producing companies--Continued

Year	Coal output (sold)		Revenues, millions		Coal as percent of total sales	Coal net income, millions	Net profit, millions	Average shareholders equity, millions	Average invested capital, millions	Return on average, percent		Coal capital expenditures, millions
	Million short tons	Percent of industry total	Total	Coal						Shareholders equity	Invested capital	
STANDARD OIL CO. (OHIO)												
1974..	9.5	1.6	$2,166.2	$114.7	5.3	$31.5	$147.5	$1,175.8	$1,983.8	12.6	8.4	$20.4
1973..	11.5	2.0	1,482.0	84.6	5.7	12.4	89.4	1,091.0	1,633.1	8.2	7.0	5.7
1972..	11.2	1.9	1,366.0	78.2	5.7	11.6	57.5	1,047.1	1,608.4	5.4	5.1	16.3
1971..	10.5	1.9	1,317.5	66.3	5.0	12.7	54.7	1,017.8	1,587.1	5.3	5.3	3.8
1970..	11.7	1.9	1,294.3	65.2	5.0	10.9	69.0	987.1	1,398.0	6.9	7.0	3.5
1969..	12.0	2.1	1,144.4	55.2	4.8	7.8	51.4	747.6	948.9	6.9	7.2	5.0
GULF OIL CORP.												
1974..	7.5	1.3	17,952.0	53.0	0.3	(9)	1,065.0	5,949.0	8,187.5	17.9	14.5	14.0
1973..	8.1	1.4	9,843.0	47.0	.5	(9)	800.0	5,489.0	7,861.0	14.6	11.9	11.0
1972..	7.5	1.3	7,624.0	42.0	.5	(9)	197.0	5,465.0	8,099.0	3.6	4.3	14.0
1971..	7.1	1.3	7,205.0	NA	NA	(9)	561.0	5,399.5	7,871.5	10.4	8.9	NA
1970..	7.8	1.3	6,597.0	NA	NA	(9)	550.0	5,159.0	7,258.0	10.7	9.1	NA
1969..	7.6	1.4	6,110.0	NA	NA	(9)	611.0	4,895.5	6,733.5	12.5	10.4	NA
UTAH INTERNATIONAL INC.[10]												
1974..	7.1	1.2	501.2	NA	NA	NA	96.9	413.9	777.5	23.4	15.4	NA
1973..	7.2	1.2	332.4	NA	NA	NA	55.4	356.6	701.2	15.6	10.6	NA
1972..	6.7	1.1	226.5	NA	NA	NA	44.0	316.2	605.8	13.9	9.7	NA
1971..	6.8	1.2	118.4	NA	NA	NA	38.3	279.3	480.9	13.7	8.8	NA
1970..	5.5	.9	101.8	NA	NA	NA	32.4	194.6	329.6	16.7	11.2	NA
1969..	3.1	.6	67.4	NA	NA	NA	26.7	119.6	250.6	22.3	12.9	NA
GENERAL DYNAMICS CORP.												
1974..	7.0	1.2	1,968.4	[11]334.7	[11]17.0	[11]43.8	52.9	425.6	630.8	12.4	12.9	NA
1973..	8.7	1.5	1,641.8	[11]70.6	[11]16.5	[11]27.6	41.3	382.9	599.5	10.8	9.8	NA
1972..	10.0	1.7	1,539.4	[11]230.9	[11]15.0	[11]18.7	24.3	351.0	571.2	6.9	7.7	NA
1971..	11.5	2.1	1,868.8	[11]222.2	[11]11.9	[11]22.3	22.0	327.7	545.9	6.7	7.9	NA
1970..	14.1	2.3	2,223.6	[11]212.3	[11]9.6	[11]24.2	-6.5	322.6	525.6	-2.0	3.0	NA
1969..	14.0	2.5	2,508.8	[11]195.9	[11]7.8	[11]33.8	2.5	332.1	470.5	.8	4.2	NA
AMERICAN ELECTRIC POWER CO., INC.												
1974..	6.7	1.1	1,316.1	NA	NA	NA	186.9	1,447.1	4,760.4	12.9	9.0	34.5
1973..	6.7	1.1	966.5	NA	NA	NA	182.6	1,233.4	4,201.8	14.8	8.8	2.4
1972..	5.4	.9	860.6	NA	NA	NA	156.3	1,098.0	3,622.1	14.2	8.4	7.1
1971..	4.8	.9	748.2	NA	NA	NA	135.0	982.8	3,060.4	13.7	8.1	7.6
1970..	5.6	.9	665.7	NA	NA	NA	116.9	828.9	2,648.9	14.1	8.0	1.2
1969..	4.7	.8	612.5	NA	NA	NA	106.3	712.6	2,310.0	14.9	7.7	2.3
COAL SUBSIDIARIES ONLY OF AMERICAN ELECTRIC POWER CO., INC.												
1974..	-	-	-	67.4	100.0	6.4	6.4	54.0	58.5	11.9	12.1	-
1973..	-	-	-	42.1	100.0	2.3	2.3	32.3	40.0	7.1	7.0	-
1972..	-	-	-	40.1	100.0	1.0	1.0	23.9	31.3	4.2	4.3	-
1971..	-	-	-	35.5	100.0	.7	.7	17.2	22.5	4.4	4.4	-
1970..	-	-	-	28.2	100.0	.8	.8	16.0	19.0	4.8	4.3	-
1969..	-	-	-	17.6	100.0	.7	.7	15.6	17.8	4.7	4.2	-
PACIFIC POWER AND LIGHT CO.												
1974..	[e]6.5	1.1	247.0	NA	-	[12]6.8	45.7	449.8	1,292.5	10.2	8.2	NA
1973..	6.6	1.1	236.0	NA	-	[12]3.2	45.1	398.5	1,132.1	11.3	8.0	NA
1972..	4.3	.7	200.1	NA	-	[12].5	41.1	339.2	1,008.4	12.1	7.9	NA
1971..	-	-	180.2	-	-	-	33.8	284.3	901.2	11.9	7.5	NA
VALLEY CAMP COAL CO.												
1974..	6.2	1.0	71.7	70.3	98.0	4.9	4.9	41.4	47.1	11.9	12.2	8.7
1973..	6.7	1.1	63.4	62.1	98.0	2.4	2.4	38.5	45.7	6.2	6.7	4.4
1972..	8.0	1.3	60.5	59.3	98.0	1.7	1.7	36.8	45.5	4.5	4.9	4.3
1971..	8.1	1.5	56.7	56.1	99.0	-.1	-.1	35.8	45.4	-.3	1.2	6.8
1970..	10.4	1.7	63.1	62.5	99.0	3.4	3.4	34.4	44.2	9.8	9.2	4.8
1969..	8.4	1.5	52.7	52.2	99.0	-.6	-.6	34.0	43.4	-1.7	-.2	3.3
INDUSTRIAL FUELS CORP.												
1974..	5.7	1.0	133.4	133.2	100.0	3.9	3.9	4.4	5.3	88.2	88.0	1.4
1973..	4.0	.7	34.8	34.7	100.0	-.1	-	2.5	3.5	.9	8.2	.1
1972..	5.5	.9	41.3	41.2	100.0	.2	.2	1.8	2.1	12.6	17.6	-
1971..	6.5	1.2	38.8	38.8	100.0	.6	.6	.8	.8	72.3	72.3	.3
1970..	5.6	.9	25.0	25.0	100.0	.3	.3	NA	NA	NA	NA	NA
1969..	4.6	.8	13.1	13.1	100.0	.1	.1	NA	NA	NA	NA	NA
ROCHESTER AND PITTSBURGH COAL CO.												
1974..	4.6	0.8	79.4	77.2	97.2	7.8	7.8	25.4	53.1	30.9	20.3	8.7
1973..	4.7	.8	56.2	54.8	97.5	3.1	3.1	21.7	46.4	14.2	11.6	3.6
1972..	5.1	.9	52.8	51.9	98.3	2.9	2.9	19.7	44.0	14.6	10.2	4.8
1971..	4.3	.8	44.1	43.4	98.4	.8	.8	18.4	42.2	4.2	5.8	4.5
1970..	4.7	.8	44.0	43.0	97.7	2.6	2.6	16.7	40.3	15.7	11.4	2.3
1969..	4.7	.8	35.4	35.0	98.9	-2.8	-2.8	16.9	40.0	-16.8	-2.3	3.0
HOUSTON NATURAL GAS CORP.[13]												
1974..	4.5	0.8	491.5	38.9	7.9	3.4	42.6	226.9	509.9	18.8	11.0	7.9
1973[14]	4.3	.7	348.6	32.2	9.3	2.9	27.7	197.6	483.4	14.0	8.7	NA
1972..	4.0	.7	302.5	25.3	8.4	1.5	21.2	174.0	445.9	12.2	8.1	NA
1971..	4.8	.8	269.3	25.5	9.5	4.1	19.7	155.2	420.7	12.7	[e]7.9	NA
1970..	4.8	.8	220.7	19.4	8.8	1.5	16.7	142.5	378.3	11.7	[e]7.1	NA
FALCON SEABOARD INC.												
1974..	3.4	0.6	47.0	37.2	79.2	9.2	14.4	14.0	31.0	102.6	53.2	8.6
1973..	3.7	.6	29.8	24.2	81.2	3.9	4.0	6.7	28.7	59.4	21.7	3.5
1972..	4.1	.7	27.6	22.9	83.0	3.0	1.3	5.3	32.4	24.0	11.0	3.1
1971..	3.8	.7	21.6	16.7	77.3	.2	-10.0	10.2	43.1	-97.7	-18.0	2.2
1970..	[15].9	.2	9.0	4.1	45.6	.4	-2.0	15.4	43.8	-13.0	-2.0	10.0
1969..	-	-	3.2	-	-	-	.7	15.5	30.6	4.3	4.2	-

See footnotes at end of table.

TABLE 7. - Financial analysis of selected U.S. coal-producing companies--Continued

Year	Coal output (sold)		Revenues, millions		Coal as percent	Coal net income,	Net profit,	Average shareholders	Average invested	Return on average, percent		Coal capital
	Million short tons	Percent of industry total	Total	Coal	of total sales	millions	millions	equity, millions	capital, millions	Shareholders equity	Invested capital	expenditures, millions
GULF RESOURCE CHEMICAL CORP.												
1974..	3.2	0.5	$244.8	$61.9	25.3	$31.4	$36.2	$58.9	$148.0	61.5	29.5	$23.4
1973..	2.6	.4	145.7	21.3	14.7	3.5	7.4	36.8	106.9	20.2	12.0	2.2
1972..	2.3	.4	125.6	17.3	13.9	3.0	4.0	30.2	88.1	13.3	9.5	4.1
1971..	2.1	.4	115.2	15.5	13.5	4.0	-23.9	40.9	94.4	-58.4	-21.1	4.5
1970[16]	2.0	.3	114.4	13.7	12.0	5.7	5.3	51.3	105.7	10.3	8.9	.9
1969..	1.6	.3	113.7	7.9	7.0	2.1	-8.9	54.4	112.8	-16.4	-4.2	2.9
ALABAMA BY-PRODUCTS CO.												
1974..	3.1	0.5	113.1	53.9	47.7	3.1	12.5	62.1	92.0	20.1	16.0	20.7
1973..	3.2	.5	76.9	36.6	47.6	2.3	7.8	54.2	70.7	14.4	12.5	18.6
1972..	2.8	.5	63.9	24.9	39.0	1.6	6.9	49.0	57.9	14.0	12.6	12.1
1971..	1.6	.3	48.0	13.5	28.1	1.0	5.8	44.7	48.1	13.0	12.0	14.9
1970..	1.9	.3	42.8	10.6	24.8	1.1	4.7	41.3	41.6	11.4	11.3	3.0
1969..	1.7	.3	32.4	9.4	29.0	.8	4.0	38.6	38.8	10.3	10.2	6.0
CARBON INDUSTRIES INC.												
1974..	2.8	0.5	76.6	72.8	95.0	14.3	14.3	43.1	51.0	33.3	28.2	8.1
1973..	3.0	.5	38.7	36.0	93.0	2.4	2.4	36.0	40.5	6.7	5.9	8.8
1972..	3.1	.5	35.1	33.6	96.0	2.9	2.9	31.7	34.6	9.2	8.4	8.7
1971..	2.5	.5	27.8	25.7	93.0	2.8	2.8	27.0	28.9	10.4	9.7	6.5
1970..	3.2	.5	26.5	22.8	86.0	3.2	3.2	24.5	25.9	13.1	12.4	6.0
1969..	3.9	.5	24.6	21.1	e86.0	3.0	3.0	21.9	22.6	13.7	13.3	NA
RAPOCA ENERGY INC.												
1974..	1.8	0.3	49.4	49.4	100.0	6.8	6.8	4.2	11.5	162.6	66.3	2.0
1973[17]	1.0	.2	10.4	10.4	100.0	-.6	-.6	1.4	7.7	-43.9	e2.5	.7
WESTRANS INDUSTRIES INC.												
1974..	1.4	0.2	30.8	28.7	93.2	14.1	8.4	18.1	26.7	46.7	34.3	2.5
1973..	1.4	.2	16.0	13.1	81.9	3.1	.8	13.3	24.4	5.7	6.5	.8
1972..	1.2	.2	11.6	9.1	78.5	2.6	1.3	12.0	20.1	11.1	9.8	6.2
1971..	.7	.1	6.5	5.3	81.5	1.6	.7	8.8	11.6	7.8	8.3	.6
1970..	.7	.1	4.1	3.5	85.4	1.0	.5	6.0	9.0	7.4	6.5	1.9
1969..	.7	.1	5.1	4.3	84.3	1.4	.4	5.4	8.5	6.6	6.5	2.7
APPALACHIAN RESOURCE CO.[18]												
1974..	0.8	0.1	8.8	8.8	100.0	1.5	1.5	2.7	4.1	54.8	40.5	1.2
1973..	.6	.1	6.8	6.8	100.0	.2	.2	1.8	3.1	11.4	10.3	1.0
1972..	.6	.1	4.9	4.9	100.0	-.3	-.3	1.3	2.7	-19.9	-5.4	.9
1971..	.8	.1	4.7	4.7	100.0	.5	.5	.6	1.6	76.0	36.0	.9
1970..	.5	.1	2.9	2.9	100.0	-.3	-.3	.4	.7	-65.7	-26.7	NA
DIAMOND COAL CO.												
1974..	0.8	0.1	10.5	10.5	100.0	2.9	2.9	4.4	5.1	66.1	58.4	1.9
1973..	.9	.2	6.8	6.8	100.0	1.9	1.9	2.6	4.1	73.1	51.2	2.1
1972..	.8	.1	5.1	5.1	100.0	.9	.9	1.1	3.3	76.2	32.0	.2
1971..	.8	.1	4.4	4.4	100.0	.3	.3	.5	3.4	62.0	12.3	.5
1970..	.7	.1	3.9	3.9	100.0	.5	.5	.4	3.7	135.9	e15.1	.3
1969..	.6	.1	2.2	2.2	100.0	.1	.1	.1	3.4	95.7	e2.8	.6
TOTAL[19]												
1974..	354.3	59.2	62,232.5	4,916.7	7.9	646.7	4,070.6	23,448.0	39,013.9	17.4	a[20]24.5	692.2
1973..	365.5	62.2	40,703.3	2,938.8	7.2	116.7	2,528.7	20,977.4	35,738.2	12.1	a[20]10.6	423.7

eEstimated. NA--Not available. NAp--Not applicable.
[1]Includes about 4 million tons of Tennessee Valley Authority coal.
[2]Includes chemical unit.
[3]Became coal producer--October 1969 through acquisition of Ayrshire Collieries Corp.
[4]Fiscal year ends September 30.
[5]Includes other small operations.
[6]Includes 1.6 million tons of Tennessee Valley Authority coal.
[7]Coal production started November 1970.
[8]Acquired A. T. Massey Coal Co., January 1974--treated as a pooling of interest.
[9]Management objective--net income of $1 per ton of coal.
[10]Fiscal year ends October 31.
[11]Includes material service and resource operations.
[12]Equity in earnings of coal joint venture.
[13]Fiscal year ends July 31.
[14]1973 and prior years restated to pooling of interest of Zeigler Coal Co., acquired December 14, 1973.
[15]Coal production started October 1970.
[16]C&K Coal Co., acquired January 16, 1970--pooling of interest.
[17]Acquired Rapoca Resources Inc., May 1973.
[18]Fiscal year ends April 30. Became private business December 18, 1974; coal business started 1969.
[19]Data may not add to totals nor equal percentages shown because of independent roundings.
[20]Simple average.

NOTE.--Minus sign indicates deficit or loss.
Source: Companies'10K's,U5S's, Proxy Statements (Securities and Exchange Commission), and annual reports.

Definitions and Quantitative (Performance) Measurements

There are many factors that contribute to the profit behavior of the coal industry, some of which are not readily subject to quantitative analysis; for example, in coal mining--underground or surface mining, in types of coal--steam or metallurgical, and in sales--spot-market (demand price) or long-term contracts as for utilities and export. The influences of these elements are reflected in the profitability of the various companies.

For this analysis, two traditional measures of return on investment are applied. The averages of shareholders' equity and of total invested capital were employed to avoid extreme rate variance due to significant amount at the beginning or at the end of the year. The definitions of the terms used in this study are as follows:

Net income or earnings (P)--Company profits after taxes, after extraordinary charges or credits, and available to shareholders.

Interest cost (I_1)--Interest and financing charges on long-term indebtedness (bond, debentures, etc.).

Shareholders' equity (E)--Common stock plus surplus (retained earnings), surplus reserves, unamortized debt premium, capital stock premium, less treasury stock plus convertible preferred stock; (E_1)--beginning of year, (E_2)--end of the year.

Total invested capital (V)--Long-term debt, minority interest, preferred stock, deferred items (taxes and others), investment tax credit, and shareholders' equity; (V_1)--beginning of year, (V_2)--end of the year.

Rate of return (R_1)--Average shareholders' equity.

Rate of return (R_2)--Average total invested capital.

$$R_1 = \frac{P}{\left(\frac{E_1 + E_2}{2}\right)} = P\left(\frac{2}{E_1 + E_2}\right) = \text{Return of average shareholders' equity.} \quad (1)$$

$$R_2 = \frac{P + I_1}{\left(\frac{V_1 + V_2}{2}\right)} = (P + I_1)\left(\frac{2}{V_1 + V_2}\right) = \text{Return on average total invested capital.} \quad (2)$$

Equation 1 is often referred to as the "financial" ratio. This measures the earning power of the corporation from the proprietary (equity) point of view. Equation 2 provides an indication of the economic productivity of capital. It is a measure of the earning power of the corporation (operating efficiency) from the standpoint of the suppliers of capital (both borrowed and proprietary).

Thirty Selected Coal-Producing Companies

The rates of return of the coal companies (table 7) indicate a general decrease since 1969 with a small increase in 1973 and a sharp upturn in 1974. During this period, the shareholders' equity and the total invested capital of nearly all selected companies have increased each year (1969-74). This trend appears to indicate that these coal producers were not severely impeded in attracting new capital. However, a higher interest rate than the usual market rate was probably required. Also, non-coal-related business activities of the parent firms may have shown profit potential more attractive to new capital.

The table shows that rates of return for certain companies on average shareholders' equity are significantly higher than those on average total invested capital. This indicates that such firms have increased their return on equity through financial leverage; that is, the use of fixed-interest debt. Interest on such debt is a tax-deductible expense. Capital managers find leverage profitable to amplify return on equity. However, this financial leverage may become a disadvantage as soon as the cost of additional capital rises with the degree of leverage. Also, such a practice can be highly risky. As soon as there is a substantial downturn in earnings, it may be impossible for a firm to meet its debt repayment obligations.

The total sales of all selected companies except one have increased from year to year. This happened up to 1973 for Eastern Associated Coal, a subsidiary of Eastern Gas and Fuel Associated (a holding company). The reason for the decrease in sales is quite obvious, as indicated by the year-to-year decline in its coal production.

The downward trend in coal earnings since 1969 with a climax represented by large losses was reported in 1973 by Kennecott Copper Corp. (Peabody Coal Co.--subject to divesture order but filed petition for reconsideration), Continental Oil Co. (Consolidation Coal Co.), and Eastern Gas and Fuel Associates (Eastern Associated Coal Corp.). The decline was the result of a drop in productivity of 25 to 30 percent and of long-term pricing problems of the companies. Price constraints are now removed and price adjustments have been effected on long-term sale contracts in export and steam coal.

In 1974, most companies showed a decline in production but an increase in sales. The unusual profits of 1974 resulted in a sharp increase in rates of return on equity and on invested capital and reversed the downward trend in coal earnings. This should generate adequate cash flow and provide the necessary incentive to attract new capital in the public money market without exorbitant interest costs. The exceptional earnings were further helped by price controls on other fuels, a shift away from the use of imported oil, enormous hedge buying against the 1974 strike, and the fact that coal enjoyed a sellers market. However, the 1-year performance due to unique circumstances of oil and the actions of OPEC nations is not an acceptable measurement in the money market. The demand or spot prices have already softened during the first half of 1975, especially for metallurgical coal since steel demand has lessened. Prices are expected to stabilize after inventory

liquidation and as more existing and new power generators are required (Government order) to use coal.[7]

Both internal and external capital sources will be essential to meet the cost of opening new mines. This cost has been rising at an average of more than 12 percent per year since 1965. The leadtime for opening a new large mine has ranged from 3 to 5 years. These increases in cost and leadtime also apply to the procurement of major mining and transportation equipment. The Government now recognizes that if mines are to be opened, adequate corporate cash flow must be aided through the tax system; for example, investment tax credits. This and other tax incentives are explained in detail in the President's State of the Union Message of January 16, 1975.[8]

In addition to the foregoing tax incentives, and not just to achieve the goals proclaimed in Project Independence, the Government has recommended changes in the Clean Air Act of 1970 that would permit burning of higher sulfur coal by utilities until technology becomes available to economically remove pollutants. Then the companies could execute new long-term coal purchase contracts to provide financial guarantees in the form of loans to coal mining companies. Concurrently, this could permit coal firms to issue or float more long-term debt at lower interest rates. This can be especially helpful if individual debts are tied to particular ventures with the utilities (purchasers) guaranteeing payment. The North American Coal Co. has already effected such an arrangement by having certain issues guaranteed by a group of utility companies, illustrating a solution to the problems of the coal companies seeking external financing (issuance of debt in public money market) for expansion and opening of mines to meet emerging demand for coal. However, the problem is compounded by the current financial difficulties of the utility companies, who find their revenue-generating capacity limited by rate approvals insufficient to support profitability acceptable to the debt or equity markets. For example, several utility companies are planning to sell their properties such as buildings, coal reserves, transportation equipment, and leasing them back to ease their liquidity problems.

Many of the coal firms follow full cost accounting; that is, capitalizing development, acquisition, and exploration costs, while others expense such items to current operations. The latter procedure provides reduction in current tax liability, and companies that follow this accounting practice are looking to possible future high returns. These accounting differences and various inventory valuation methods are the problem areas of comparability. A coal-producing division of a multiproduct company is another problem area because profitability from coal operations is often masked by another product-line performance. However, current product-line reporting as required by the Securities and Exchange Commission may help to rectify this problem.

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[7]For further pricing information, see the section entitled, "Macrofinancial Analysis."

[8]U.S. Congress. Tax Reduction Act of 1975. Public Law 94-12, Mar. 29, 1975, 89 Stat. 36-53 (incl.).

Another problem in interfirm comparisons of profitability is that different types of companies may treat the profitability of their coal divisions in different ways. A conglomerate with a coal-producing subsidiary will treat the coal division as a profit center, and its profitability is expected to approximate that of the other divisions in the organization. A steel company or a public utility on the other hand will treat its coal-producing subsidiary as a step in its production process, a necessary raw material for steel or electricity. Although there will be financial controls to assure efficient operation, the coal division will probably not be treated as a profit center; the profit center is the sale of steel or electricity.

Twelve Selected Coal (Primary) Producing Companies

Table 8 assembles 12 coal (primary) producers with financial information to assess the economic health of these coal companies per se and current trends. More small coal operators are incorporating and entering the money market to raise capital (both equity and debt) for opening of new mines, purchase of small producers, of coal reserves, and more efficient equipment.

It is important to note in this evaluation that types of coal and methods of mining significantly influence the rates of return. For example, Valley Camp Coal Co. mines nearly all its steam coal underground, whereas another firm may produce such coal through surface mining, where there is considerable advantage in productivity and in mining costs. Westmoreland Coal Co.'s principal business is metallurgical coal (nearly 60 percent of its total sales); more than 25 percent of its production is exported to locations where price control was not applicable. Metallurgical coal is higher priced than steam coal. These factors, therefore, should be considered in the assessment of a coal producer's performance and when each firm is contrasted to the measurements of the total coal industry.

Companies that entered the coal business within the past 2 to 4 years show extreme swings in profitability. Initial periods were difficult due to heavy, expensive borrowings (debt). The 1974 profits helped the debt-equity ratio and cash flow to meet due obligations and for expanding and improving coal mines.

TABLE 8. - Financial analysis of selected U.S. coal (primary) producing companies

Year	Coal output (sold)		Revenues, millions		Coal as percent of total sales	Coal net income, millions	Net profit, millions	Average shareholders equity, millions	Average invested capital, millions	Return on average, percent		Coal capital expenditures, millions
	Million short tons	Percent of industry total	Total	Coal						Shareholders equity	Invested capital	
WESTMORELAND COAL CO.												
1974	13.2	2.2	$420.0	$399.0	95.0	$45.0	$36.2	$82.6	$107.3	43.8	35.6	$20.4
1973	13.0	2.2	185.8	173.5	93.4	2.9	4.7	65.3	89.7	7.2	5.9	18.0
1972	13.2	2.2	169.3	160.0	94.5	5.1	4.4	63.5	74.7	6.9	6.0	22.7
NORTH AMERICAN COAL CORP.												
1974	11.3	1.9	161.4	161.4	100.0	4.9	4.9	36.0	182.5	13.7	10.4	17.4
1973	12.4	2.1	125.2	125.2	100.0	4.5	4.5	32.4	168.7	13.9	8.2	23.8
1972	12.0	2.0	100.0	100.0	100.0	2.6	2.6	29.7	145.8	8.9	6.9	37.0
EASTERN GAS AND FUEL ASSOCIATES (COAL OPERATION ONLY)												
1974	10.4	1.7	281.9	256.5	91.0	31.4	34.1	90.7	183.4	37.6	19.8	23.4
1973	12.1	2.1	161.4	145.2	90.0	-2.4	-.3	77.1	165.0	-.4	1.8	3.4
1972	14.4	2.4	169.7	157.8	93.0	3.6	4.8	84.9	152.7	5.7	4.7	5.3
VALLEY CAMP COAL CO.												
1974	6.2	1.0	71.7	70.3	98.0	4.9	4.9	41.4	47.1	11.9	12.2	8.7
1973	6.7	1.1	63.4	62.1	98.0	2.4	2.4	38.5	45.7	6.2	6.7	4.4
1972	8.0	1.3	60.5	59.3	98.0	1.7	1.7	36.8	45.5	4.5	4.9	4.3
INDUSTRIAL FUELS CORP.												
1974	5.7	1.0	133.4	133.2	100.0	3.9	3.9	4.4	5.3	88.2	88.0	1.4
1973	4.0	.7	34.8	34.7	100.0	-.1	-	2.5	3.5	.9	8.2	.1
1972	5.5	.9	41.3	41.2	100.0	.2	.2	1.8	2.1	12.6	17.6	-
ROCHESTER AND PITTSBURGH COAL CO.												
1974	4.6	0.8	79.4	77.2	97.2	7.8	7.8	25.4	53.1	30.9	20.3	8.7
1973	4.7	.8	56.2	54.8	97.5	3.1	3.1	21.7	46.4	14.2	11.6	3.6
1972	5.1	.9	52.8	51.9	98.3	2.9	2.9	19.7	44.0	14.6	10.2	4.8
ALABAMA BY-PRODUCTS CO.												
1974	3.1	0.5	113.1	53.9	47.7	3.1	12.5	62.1	92.0	20.1	16.0	20.7
1973	3.2	.5	76.9	36.6	47.6	2.3	7.8	54.2	70.7	14.4	12.5	18.6
1972	2.8	.5	63.9	24.9	39.0	1.6	6.9	49.0	57.9	14.0	12.6	12.1
CARBON INDUSTRIES INC.												
1974	2.8	0.5	76.6	72.8	95.0	14.3	14.3	43.1	51.0	33.3	28.2	8.1
1973	3.0	.5	38.7	36.0	93.0	2.4	2.4	36.0	40.5	6.7	5.9	8.8
1972	3.1	.5	35.1	33.6	96.0	2.9	2.9	31.7	34.6	9.2	8.4	8.7
WESTRANS INDUSTRIES INC.												
1974	1.4	0.2	30.8	28.7	93.2	14.1	8.4	18.1	26.7	46.7	34.3	2.5
1973	1.4	.2	16.0	13.1	81.9	3.1	.8	13.3	24.4	5.7	6.5	.8
1972	1.2	.2	11.6	9.1	78.5	2.6	1.3	12.0	20.1	11.1	9.8	6.2
RAPOCA ENERGY CORP.[1]												
1974	1.8	0.3	49.4	49.4	100.0	6.8	6.8	4.2	11.5	162.6	66.3	2.0
1973	1.0	.2	10.4	10.4	100.0	-.6	-.6	1.4	7.7	-43.9	[e]2.5	.7
APPALACHIAN RESOURCE CO.												
1974	0.8	0.1	8.8	8.8	100.0	1.5	1.5	2.7	4.1	54.8	40.5	1.2
1973	.6	.1	6.8	6.8	100.0	.2	.2	1.8	3.1	11.4	10.3	1.0
1972	.6	.1	4.9	4.9	100.0	-.3	-.3	1.3	2.7	-19.9	-5.4	.9
DIAMOND COAL CO.												
1974	0.8	0.1	10.5	10.5	100.0	2.9	2.9	4.4	5.1	66.1	58.4	1.9
1973	.9	.2	6.8	6.8	100.0	1.9	1.9	2.6	4.1	73.1	51.2	2.1
1972	.8	.1	5.1	5.1	100.0	.9	.9	1.1	3.3	76.2	32.0	.2
TOTAL												
1974	62.1	10.3	1,437.0	1,321.7	92.0	140.6	138.2	415.1	769.1	33.3	[2]35.8	116.4
1973	63.0	10.7	782.4	705.2	90.1	19.7	26.9	345.4	669.5	7.8	[2]10.9	85.3
1972	67.7	11.1	714.2	647.8	90.7	23.8	28.3	331.5	583.4	8.5	[2]9.8	102.2

[e]Estimated.

[1]Rapoca Resources Inc. acquired Rapoca Energy Corp. in May 1973.

[2]Simple average.

NOTE.--Minus sign indicates deficit or loss.

Source: 10K's, Proxy Statements (Securities and Exchange Commission), and annual reports of the companies listed.

MACROFINANCIAL ANALYSIS OF ALL-MINING AND COAL-MINING COMPANIES

As another financial measurement, the profitability of the coal industry was compared with that of the mining industry, including coal, by screening and analyzing the tabulated data of the Corporation Income Tax Return by the Internal Revenue Service to select financial information for all-mining and coal mining companies, from 1951 to 1972, a period of 22 years that included wide swings in mining operations.[9] This time span was selected as a means of covering several complete business cycles. These data are subject to the disadvantage of aggregation as tax returns classified as "coal mining" may include financial statistics of other lines of businesses.

The same quantitative and qualitative measurement approaches utilized for the individual coal companies were applied to the aggregate corporate income tax statistics. The developed yearly aggregate rates of return on average equity and average total investment for all-mining and coal-mining industries are depicted in table 9 and in figures 5 and 6. With the exception of 1970, coal-mining companies underperformed all-mining firms, generally by significant differences, ranging from 1.3 to 8.8 percent for rates of return on average equity and 1.2 to 4.7 percent for rates of return on average total investment. The lower rates of return for coal mining as contrasted to all mining portray the competitive problems of coal with petroleum and natural gas and some of the reasons for coal companies being taken over by other resource-based industries. This happened during the 1960's when oil companies purchased many large coal operations, injecting new ideas and perspectives into coal management. The coal mining outperformed all mining due to the emerging coal demand in 1970. The drop in coal-mining performance the following years was in part due to the impact of the 1969 Health and Safety Act, which contributed to the drop in coal production.

[9]"All-mining" is an IRS designation that encompasses the entire mining industry.

TABLE 9. - Financial analysis of all-mining and coal-mining companies, 1951-72

Year	Number of returns		Net income after tax, millions		Shareholders equity, millions		Long-term debts, millions		Return on average equity, percent		Return on average invested capital, percent	
	All mining	Coal	All mining	Coal	All mining	Coal	All mining	Coal	All mining	Coal	All mining	Coal
1951	8,136	1,631	$561.8	$57.1	$7,496.5	$1,420.1	$2,904.3	$476.3	[1]7.5	[1]4.0	[1]6.0	[1]3.6
1952	7,998	1,436	469.4	34.0	7,621.9	1,446.9	3,091.0	478.0	6.2	2.4	4.5	2.4
1953	8,164	1,396	442.4	17.0	7,801.5	1,432.6	2,888.4	429.7	5.7	1.2	4.8	1.4
1954	8,704	1,197	311.6	.8	7,681.4	1,323.6	2,965.2	379.4	4.0	.1	3.6	.7
1955	9,683	1,414	482.5	33.7	8,236.4	1,435.2	3,448.1	438.0	6.1	2.4	5.1	2.5
1956	10,861	1,536	516.1	70.7	8,702.4	1,536.6	3,465.4	476.1	6.1	4.8	5.2	4.3
1957	11,532	1,549	403.7	45.4	9,240.2	1,561.3	3,450.4	531.6	4.5	2.9	4.2	3.0
1958	10,971	1,244	372.0	22.2	9,468.0	1,513.8	3,542.9	514.6	4.0	1.4	3.8	1.9
1959	12,920	1,961	175.9	8.6	9,814.9	1,501.2	3,631.0	511.4	1.9	.6	2.5	1.4
1960	13,017	1,826	236.4	8.7	10,401.2	1,512.9	3,833.0	473.5	2.3	.6	2.9	1.5
1961	13,731	1,883	327.3	34.0	10,820.2	1,497.0	4,150.9	497.1	3.1	2.3	3.4	2.7
1962	13,539	2,205	278.8	18.1	([2])	([2])	([2])	([2])	([3])	([3])	([3])	([3])
1963	14,878	2,480	576.2	35.0	10,803.8	1,477.7	3,505.1	456.5	[1]5.3	[1]2.4	[1]5.3	[1]2.8
1964	14,487	2,445	637.1	59.7	10,677.4	1,645.4	3,753.7	672.6	5.9	3.8	5.7	4.2
1965	13,285	2,159	767.8	70.2	10,115.5	1,719.3	3,217.8	671.8	7.4	4.2	6.8	4.2
1966	14,831	2,336	945.2	48.9	10,054.4	1,433.5	3,876.4	728.3	9.4	3.1	8.4	3.8
1967	14,441	2,304	765.1	35.7	10,602.2	1,352.7	3,976.0	733.7	7.4	2.6	6.8	3.5
1968	12,813	1,571	759.7	17.6	11,225.3	978.2	4,436.5	528.0	7.0	1.5	6.7	3.1
1969	14,028	1,673	664.8	-3.6	12,379.0	1,076.2	5,450.6	609.2	5.6	.4	5.8	2.1
1970	14,465	2,226	801.0	157.1	13,381.8	1,731.5	5,655.8	998.7	6.2	11.2	6.5	10.5
1971	12,613	1,664	958.8	69.0	14,483.9	1,826.7	6,378.2	872.4	6.9	3.9	6.8	5.0
1972	14,211	2,161	1,508.2	21.5	16,144.2	1,962.6	7,705.4	1,119.0	9.9	1.1	9.1	4.4

[1]Rate of return based upon end-of-the-year data.
[2]Data not tabulated.
[3]Computation not possible.

NOTE.--Minus sign indicates a deficit.

Source: Statistics of Income, Corporation Income Tax Returns, Internal Revenue Service; selected, processed, and computed by Bureau of Mines.

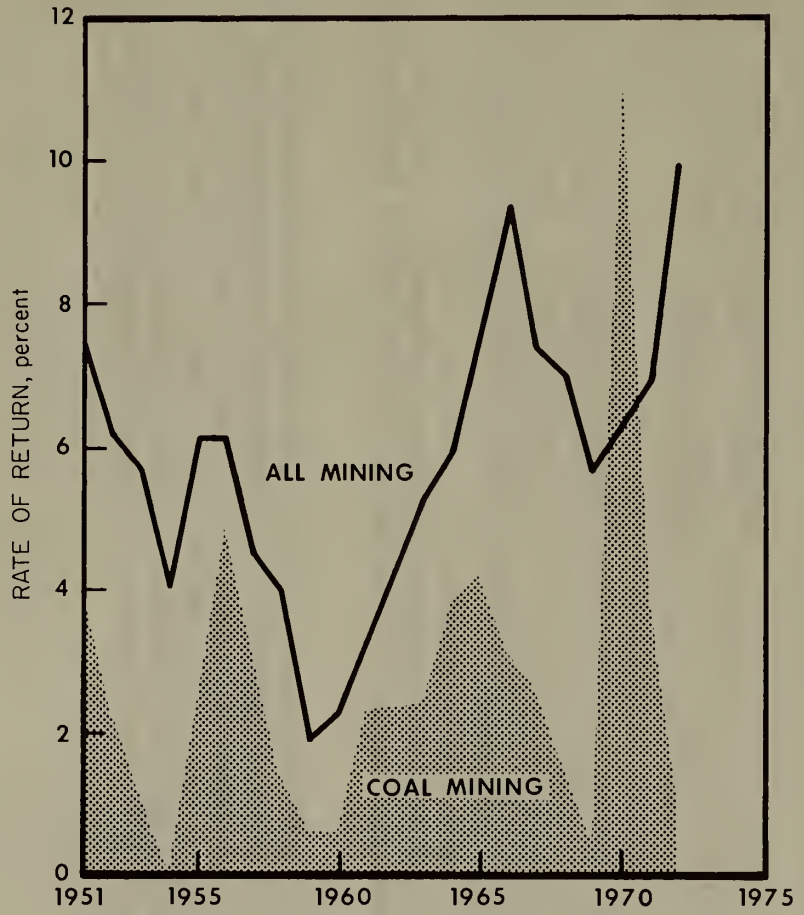

FIGURE 5. - Rates of return on average equity all-mining and coal-mining companies, 1951-72.

Source: Computed from data, Statistics of Income, Corporation Income Tax Returns, Internal Revenue Service.

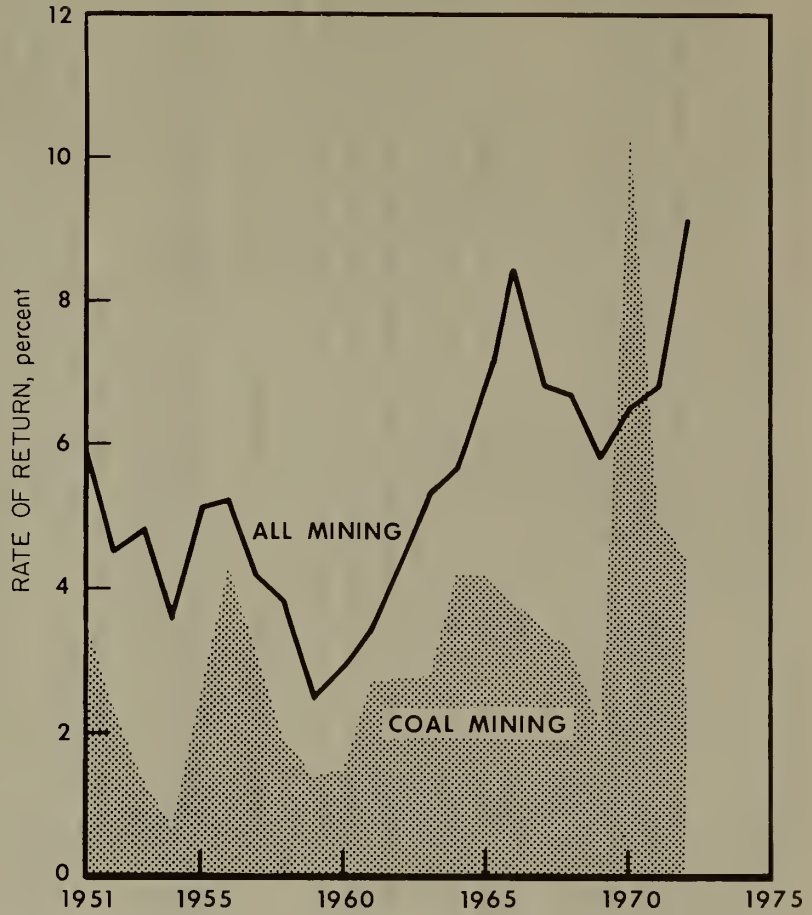

FIGURE 6. - Rates of return on average invested capital all-mining and coal-mining companies, 1951-72.

Source: Computed from data, Statistics of Income, Corporation Income Tax Returns, Internal Revenue Service.

MACROFINANCIAL ASSESSMENT AND TREND ANALYSIS IN CAPITAL STRUCTURE OF ALL-MINING AND COAL-MINING COMPANIES

Since World War II, business capital structure has been changing to more emphasis upon debt (bonds) than equity (common stock). This has contributed to a more pronounced cyclical nature of corporate earnings since high interest costs of the debt have raised companies' break-even point, producing a sharper profit drop when volume falls during a downturn in the economy.

Many companies voluntarily elected to finance through debt rather than equity because bond interest is a tax-deductible expense, and, probably in some cases, for leverage purpose. This increase in debt-equity ratio places not only a burden on interest coverage during low business activity, but also on financing capital expenditures because the internally generated cash flow may become even less adequate. All this leads to difficulty in future debt financing without improving debt equity ratios. All-mining companies likewise have followed this trend of financing by increasing the level of indebtedness, but the coal-mining companies rate was more pronounced (table 10).

TABLE 10. - Analysis of investments and trends in all-mining and coal-mining industries, 1951-72

(Money units are in million dollars)

Industries	1951	1972	Increase	Percent of change
All mining:				
Number of tax returns	8,136	14,211	6,075	0.75
Long-term debts[1]	2,904	7,705	4,801	1.65
Shareholders' equity	7,497	16,144	8,647	1.15
Total	10,401	23,849	13,448	1.29
Coal mining:				
Number of tax returns	1,631	2,161	530	.33
Long-term debts[1]	476	1,119	643	1.35
Shareholders' equity	1,420	1,963	543	.38
Total	1,896	3,082	1,186	.63

[1]Payable in 1 year or more.

Source: Statistics of Income, Corporation Income Tax Returns, Internal Revenue Service; selected, processed, and computed by Bureau of Mines.

This trend may indicate that coal companies have shown adequate earnings to issue debt instruments or that the money market sees a strong earning potential in coal. The aggregate debt-equity ratio for "all mining" and "coal mining" do not indicate that such industries have come into a critical corporate financial structure. However, several individual companies (table 7) have reached or are near such circumstances, making financing difficult without improving debt-equity ratios.

If the sharp increase in debt-equity ratios of coal corporations continues, it may create a high-leverage industry. A deterioration of company earnings will place a strain on its interest coverage, thus decreasing its bond rating. Companies with less than "A" rating may have trouble in borrowing or have to accept a higher interest rate (higher interest cost). A company's earning power relationship to overall indebtedness is the major factor in its bond rating. Accordingly, a company with a low debt ratio or no debt would be generally more acceptable in the money market.

QUALITY AND RELIABILITY OF BUSINESS DATA AND INFORMATION

The U.S. Government requires all publicly held companies to register with the Securities and Exchange Commission and to report their business operations. Such required documents and other optional material were used by this study as follows:

Annual and Quarterly Reports to Shareholders.

Annual 10-K, monthly reporting of significant events, U5S (holding company) annual reports, Proxy Statements, Securities Registration, S-1, and Prospectus to Securities and Exchange Commission.

Special Reports for Security Analyst Meetings.

Testimony before selected Congressional Special Committees, for the selected companies and their subsidiaries.

The foregoing sources have been supplemented by personal contacts with executive officers of involved companies and by information developed from other sources as well as by literature reviews of many technical periodicals and reports.

The current required disclosures in business reporting have improved the quality and quantity of financial data and were helpful in this research. However, because of nonstandardization in reporting, the study required critical in-depth analysis in the selection of appropriate information. These data were specifically collected, screened, assembled, and developed for this purpose and are not fragmented with gaps, omissions, or duplications. Every attempt has been made to utilize data supplied by the companies pursuant to law.

No attempt was made to show the impact on profitability of such variables as application of alternative methods of accounting; that is, in inventory accounting--LIFO (last-in, first-out) versus FIFO (first-in, first-out), average cost or retail prices, full costing (capitalizing acquisition and development costs), and expensing currently to operations, deferrable cost, etc. However, sufficient relevant data were collected, documented, and evaluated to develop a conclusion.

Quality data are essential for analysis.

RECENT TRENDS IN COAL INDUSTRY

Growing numbers of major steel, public utilities, chemicals, and metal companies have accelerated their coal self-sufficiency. They have recognized the importance of "captive" coal operation and are aggressively acquiring small coal companies and coal reserves to become self-sufficient in coal. For example, a Far West utility company, Pacific Gas and Electric (PG&E) has taken its first step in coal by purchasing coal reserves. PG&E has been 62 percent dependent on hydropower for its electricity, with oil and natural gas producing most of the balance. Also, the United States Steel Co., in addition to increasing its metallurgical coal supplies to meet its own needs, has entered into an agreement with Ontario Hydro (a Canadian power supplier) to develop a coal mine with production capacity of 3 million tons annually under special financial arrangement without involving United States Steel's credit. The coal would be used in a steam-generating plant.

Even the Tennessee Valley Authority (TVA), a corporate agency of the U.S. Government, the world's largest generator of electric power, has made concerted efforts to purchase (bid purchase withdrawn) Peabody Coal Co., the Nation's biggest coal producer. Currently, Peabody Coal Co. and Long Pit Coal Co. mine under contract about 4.4 million tons of TVA's coal for TVA steam-generating plants. TVA consumes about 40 million tons of coal per year, and with its needs increasing to 46 million tons, has taken actions to improve present and future coal supplies, including further mining of TVA-owned coal reserves. To increase deliveries, TVA has entered into new contracts with major coal producers such as Zeigler Coal Co. and Pittsburgh & Midway Coal Mining Co., and also with current major coal suppliers.

The other recent phenomenon is the formation of several small coal companies and existing companies adding coal ventures as principal line of business because of price actions and the profitability outlook in coal. It is estimated that about 15 companies with public issues have entered the coal business since 1971, generally through purchases of small family or unregistered coal producers.

SUMMARY AND CONCLUSIONS

Many coal companies, like other corporations, require outside capital as well as funds generated internally to expand, develop new mines, acquire coal properties or other businesses, build plants, and purchase mining and transportation equipment. Apart from cash flow (net earnings plus noncash charges), the coal companies essentially have three sources of capital: institutional investors, individual investors, and venture capitalists. The attraction for such capital is adequate profitability, which is measured by the rate of return on investment for the coal industry; that is, competitive rate of return commensurate with industry risk.

Coal is considered a cyclical industry, and as such it is susceptible to liquidity problems, such as meeting debt payments. Consequently, coal company bonds may not receive a "high-grade-safe rating," thus requiring higher than normal yield, resulting in increased cost in new capital financing. Since the current upswing in coal demand is expected to last for many years, without the

current abnormal price support from oil, coal obligations probably deserve a lower risk rate, thus reducing new capital financing costs.

Less than a decade ago, coal was a surplus commodity and experienced strong competition from inexpensive supplies of natural gas and oil. During this period, the coal industry's corporate structure changed radically. In spite of sagging profits, other resource-based companies, especially major oil firms, purchased coal companies. Today, nearly all of the top 16 coal producers are subsidiaries of petroleum, steel, metal, or public utility companies. This trend toward fewer but larger companies is expected to continue. It has become more pronounced owing to the need for large amounts of capital, not only for mine development and expansion to meet emerging coal demands but also to meet the heavy expenses of regulatory standards of health and safety and the pending environmental requirements. Meanwhile, the number of small companies--that is, those producing less than 100,000 tons per year--continues to decline because of limited capital and other difficulties.

Today's medium to large coal producers, especially the subsidiaries of parent organizations, are in a better position to compete in the capital market. Also, because domestic gas and oil production is dwindling and the prices are increasing, and supplies of nuclear energy are still plagued with problems and are years behind schedule, coal has become a viable industry with a bright, long-term future, probably shedding the cyclical status.

However, with the exception of 1970 and 1974, the coal industry's average rate of return on equity and total invested capital relative to risk have been generally inadequate to readily attract capital. For example, one coal company had to have its bond issue bear a higher than normal interest rate and be guaranteed by a group of utility companies. Others have had to use various financing methods rather than direct issuance of their equities or debt, such as selling their coal supply and transportation equipment and leasing them back. A coal company must have a return well in excess of the prime interest rate.

An analysis of the data suggests that a "coal only" producer should have an average rate of return on equity substantially above the prime interest rate, as contrasted to a coal subsidiary of a major oil company, to forestall the flow of capital toward safer debt obligations. A general observation is that currently, a coal organization should be producing a minimum of nearly 1 million tons of coal per year, and preferably 4 to 5 million tons, in order to realize economies of scale, as explained in industry transformation as to size and number of coal producers. This would place the unit within the top 25 coal producers. The tonnages should be modified as productivity increases and mining technology improves.

Though the coal industry had its share of setbacks in 1974 (such as the coal strike, and a consequent reduction in output), most coal companies showed sharply improved profits, primarily due to major price increases in coal. Such improved profits must be equated to rate of return on investments, the key measurement of an industry's profitability. For several coal companies, the rates were abnormally high. In others, where coal companies are

subsidiaries of oil corporations, coal profits contributed to total earnings, and for some companies these profits and earnings helped offset a decline in oil profits.

In addition, the coal companies must maintain an appropriate debt structure; that is, debt-to-capital ratio (not excessively leveraged). The measure of a company's credit worthiness is the bond rating. It is clear that capital flows are interest-rate sensitive. Accordingly, the coal business must provide a reasonable return on investment, commensurate with risk, to attract on an economical basis the large amounts of new capital necessary to finance new mines and equipment to meet the growing demand for coal.

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U. S. Bureau of Mines.

Information Circular 8708

Helium Resources of the United States, 1973

By B. J. Moore
Helium Operations, Amarillo, Tex.

UNITED STATES DEPARTMENT OF THE INTERIOR
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HELIUM RESOURCES OF THE UNITED STATES, 1973

by

B. J. Moore [1]

ABSTRACT

This Bureau of Mines publication reviews U.S. helium resources as of January 1, 1973. These resources, estimated to be 693.7 billion cubic feet, are broken down into four classifications, as follows: helium in storage, 34.9 billion cubic feet; helium in measured helium-rich natural gas reserves, 119.5 billion cubic feet; helium in measured helium-lean natural gas reserves, 62.8 billion cubic feet; and helium in indicated or undiscovered natural gas resources, 476.5 billion cubic feet. The helium in undiscovered natural gas is considered a national resource; however, this gas may not be discovered depending on many factors beyond the scope of this paper, and most of the helium in natural gas will be dissipated as the gas is consumed for fuel and other purposes.

INTRODUCTION

Estimates of the helium resources of the United States have been made for several years by the Bureau of Mines, Division of Helium, in connection with a search for helium occurrences that has been conducted for more than 50 years. The evaluation work on the helium resources is done to insure a continuing supply of helium to fill essential Federal needs and to provide information to the public on a limited and wasting natural resource. This responsibility of insuring a supply of helium to meet essential Federal needs was assigned to the Secretary of the Interior originally in 1925, and the latest legislation is the Helium Act Amendments of 1960. Further, the Mineral Leasing Act of 1920 reserves all helium found under Federal oil and gas leases to the United States.

The helium resources of the Nation are reported in four categories: (1) Helium in storage; (2) helium in measured helium-rich natural gas reserves; (3) helium in measured helium-lean natural gas reserves; and (4) helium in indicated and undiscovered natural gas resources. Category 1, helium in storage, is the helium stored by the Department of the Interior as part of its conservation efforts. Category 2, helium in measured helium-rich natural gas reserves, is defined as that helium in measured natural gas

[1]Chief, Section of Helium Resources Surveys, Branch of Helium Resources.

reserves having a helium content of 0.3 percent or more. Category 3, helium in measured helium-lean natural gas reserves, is defined as that helium in measured natural gas reserves having a helium content of less than 0.3 percent. Category 4, helium in indicated and undiscovered natural gas resources, includes helium in as yet undiscovered natural gas resources as estimated by the Potential Gas Committee (PGC), which is sponsored by the Colorado School of Mines Foundation, Inc. The value of 0.3 percent helium has no particular significance except that generally as the helium content goes down, the cost of recovery goes up. Helium recovery cost is a function of many other variables, such as average annual daily rate of gas processed, hydrocarbon recovery, and life of the reserves.

ACKNOWLEDGMENTS

The basic information on which the estimate of helium resources has been made has come from individual gasfields where helium has been located, and from estimates of future discoveries. Without the assistance of the oil and gas industry, State and national agencies, and many individuals engaged in oil and gas exploration, the data collection and evaluation of the Nation's helium reserves would be impossible. Clearly one of the major methods of helium resources evaluation has been to use data from industrial efforts to locate natural gas.

HELIUM RESOURCES

The helium resources of the United States, as defined for the purposes of this report, are those which occur either as a constituent of natural gas or have been previously separated from natural gas and have been stored for future use. Figure 1 shows the breakdown of these helium resources. Helium is a minor constituent of all natural gas, and the helium resources included in these estimates are found in natural gas in identified gasfields or in fields which are surmised to exist based on expert opinion. Economic extraction of the helium from these identified and undiscovered sources may be either currently or potentially feasible. Included with these resources are those helium deposits categorized as reserves. These helium reserves are defined as helium in identified gas reserves having at least 0.3 percent helium by volume and at least 100 million cubic feet of recoverable helium.

In a Department of the Interior News Release on April 15, 1974, definitions of terminology regarding categories of resources were given. These terms were jointly adopted by both the Bureau of Mines and the Geological Survey and are used throughout this report. These recently adopted terms can be compared to commonly used terms in the natural gas industry. The adopted terms and the comparable gas industry terms as used in this report are shown in figure 1 and defined in the appendix.

To estimate volumes of helium contained in natural gas, it is necessary to have some method of obtaining the helium content of natural gas resources. Helium contents used in this report came from the Bureau's records of helium analyses in natural gas. The analysis of natural gas and the evaluation of helium resources were begun in 1917. Over 14,000 analyses of natural gas

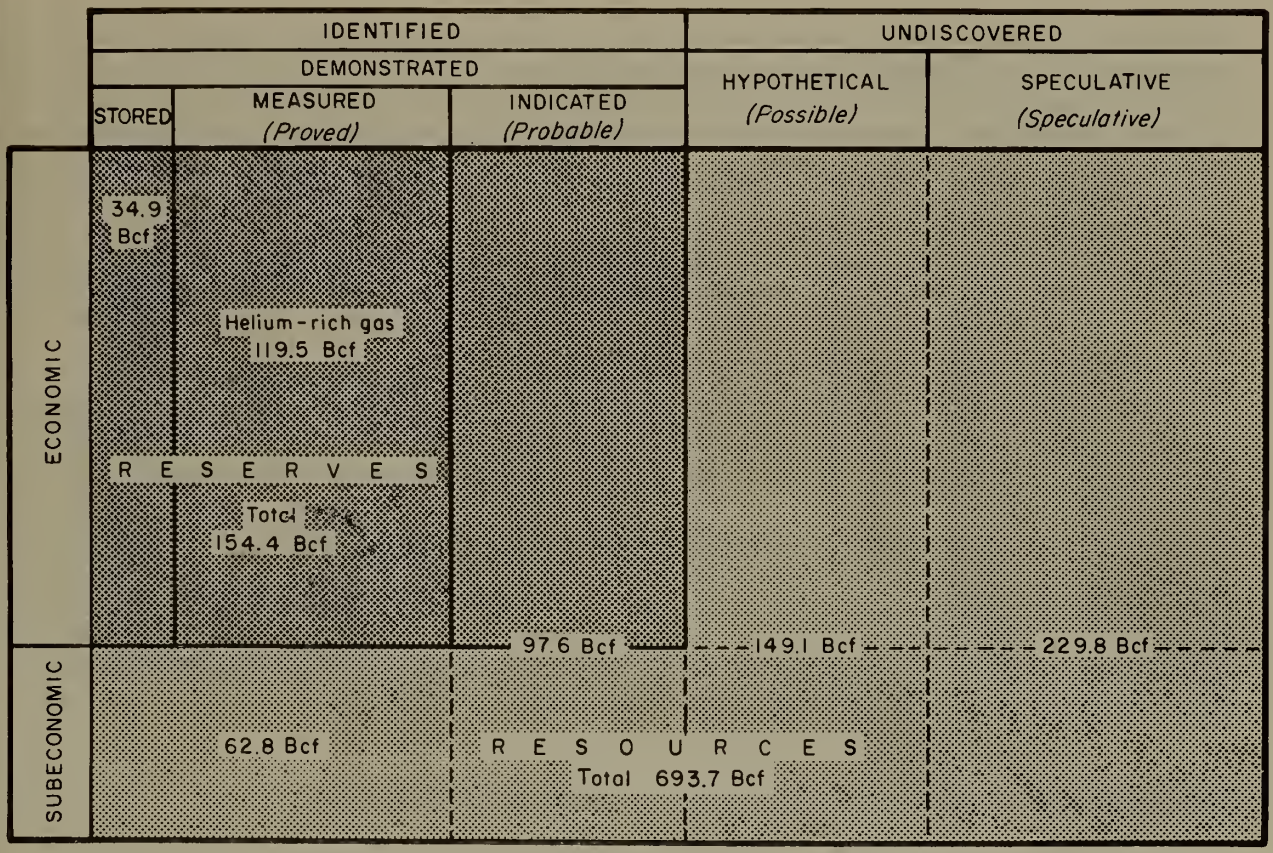

FIGURE 1. - Helium resources of the United States. Terms in parentheses are those used by the PGC and commonly used in industry. Bcf = billion cubic feet.

samples from wells and pipelines in the United States have been made. Through 1973, 10,201 of these analyses had been published in 17 Bureau of Mines publications listed in the Bibliography at the end of this report.

Helium in Storage

In 1961, the Government contracted to purchase helium from extraction plants which were built by private companies adjacent to large natural gas transmission pipelines. The gas, principally from the West Panhandle and Hugoton gasfields, was being produced for fuel, and as the gas was burned, the helium was released to the atmosphere and wasted. The helium was purchased from four private companies. Using private funds, these four companies constructed five helium extraction plants to serve the Government programs. The helium was delivered into a Government-owned pipeline which connected all plants with the Cliffside helium storage field near Amarillo, Tex.

Deliveries of helium to the Bureau of Mines for storage commenced in December 1962, and as of January 1, 1973, 31.2 billion cubic feet of helium was in underground storage. (Notice of termination of helium purchases was given March 28, 1971, to the four companies from which the Bureau was buying

helium.) In addition, 1.0 billion cubic feet of helium was stored for private companies under separate storage contracts, and 2.7 billion cubic feet of helium production from Bureau of Mines plants not currently needed to meet Federal demand was also stored by the Bureau. Thus, the total volume of helium in storage as of January 1, 1973, was 34.9 billion cubic feet.

The storage site, Cliffside field, is a partially depleted natural gasfield in which the gas and storage rights are owned by the Government. The field was the source of helium-bearing natural gas which was processed for helium extraction at the Government's Amarillo Helium Plant from 1929 until the plant ceased helium extraction operations in April 1970. These operations partially depleted the natural gas from the Cliffside field. There remains in the field about 212 billion cubic feet of natural gas with a helium content of about 1.86 percent. Helium contained in the remaining native gas is included with the helium in measured natural gas reserves.

Helium in Measured Reserves of Natural Gas

Helium in measured reserves of natural gas is divided into two classifications, helium-rich and helium-lean natural gas. These classifications are differentiated by helium content. Helium-rich natural gas is that gas which contains 0.3 percent or more helium, while helium-lean natural gas is that gas which contains less than 0.3 percent helium.

Helium in Helium-Rich Natural Gas

As of January 1, 1973, it was estimated that there were 119.5 billion cubic feet of helium contained in the measured natural gas reserves of the United States that had helium contents of 0.3 percent or more. These reserves were located in 93 fields in 10 States. Estimates of the helium reserves in helium-rich gas in each of these States are shown in table 1.

TABLE 1. - Helium reserves of the United States, by State

(Volumes in million cubic feet at 14.73 psia and 60° F)

State	MMcf of helium
Arizona	1,789
Colorado	1,660
Kansas	55,336
Montana	581
New Mexico	733
Oklahoma	13,345
Texas	39,666
Utah	3,031
West Virginia	112
Wyoming	3,262
Total United States	119,515

The Bureau of Mines has made estimates of helium reserves in the Nation since 1950. Each year, as more data were collected and additional experience was gained, these estimates have been more comprehensive and more specific.

In the first efforts of estimating helium reserves, estimates were confined to the helium contained in the major helium-rich natural gasfields in the Oklahoma and Texas Panhandles and in southwest Kansas. Fields included in these estimates were Hugoton, which extended from Kansas through the Oklahoma Panhandle and into the Texas Panhandle, West Panhandle in Texas, Greenwood in Kansas, Keyes in Oklahoma, and Cliffside in Texas. These fields still contain the bulk, over 85 percent or 103.1 billion cubic feet, of the helium reserves in the Nation's helium-rich gas. The natural gas that makes up this 85 percent of the rich-helium reserves is being produced for fuel, and the helium is lost with the flue gas.

In 1961, a program was initiated to estimate the helium reserves of all fields from which samples of helium-rich gas had been analyzed in connection with the helium evaluation program. Data on these smaller fields have been collected from all known available sources over these intervening years, and this information has been evaluated to assess the total helium reserves of the country. The helium reserves estimates for each year beginning in 1950 appear in table 2. Table 2 also compares the trend of helium reserves of the United States with the natural gas reserves as estimated by the American Gas Association (AGA).

TABLE 2. - Helium and natural gas reserves estimates from 1950 through 1973

(Volumes in million cubic feet at 14.73 psia and 60° F)

Beginning of year[1]	Helium in helium-rich natural gas	Helium in storage	AGA estimates of natural gas reserves
1950	248,642	82	179,401,693
1951	242,675	81	184,584,745
1952	242,675	86	192,758,910
1953	235,713	87	198,631,566
1954	229,745	86	210,298,763
1955	222,783	86	210,560,931
1956	216,816	70	222,482,544
1957	210,849	46	236,483,215
1958	203,887	24	245,230,137
1959	197,919	17	252,761,792
1960	192,946	106	261,170,431
1961	194,373	268	262,326,326
1962	194,373	438	266,273,642
1963	191,311	509	272,278,858
1964	187,855	2,042	276,151,233
1965	177,886	5,317	281,251,454
1966	169,695	8,870	286,468,923
1967	163,589	12,407	289,332,805
1968	155,076	16,138	292,907,703
1969	148,408	19,863	287,349,852
1970	140,386	23,693	275,108,835
1971	135,850	27,573	290,746,408
1972	127,873	31,491	278,805,618
1973	119,515	34,903	266,084,846

[1]AGA reserve estimates are given as of December 31 of previous year.

All of the large reserves of helium mentioned previously, except the native gas in Cliffside field, and most of the smaller reserves are being produced for fuel. This resulted in about 8.4 billion cubic feet per year of helium being lost without beneficial use. The purchases of helium extracted under contract saved an average of about 3.5 billion cubic feet of this once wasting helium from 1963 through contract termination. In 1972, about 4.1 billion cubic feet of helium was extracted; however, the balance, or 4.3 billion cubic feet, was produced with the natural gas and lost to the atmosphere without beneficial use.

In addition to the fields now being depleted of their helium reserves because of production of natural gas for fuel, there are several fields containing helium-rich gas that are not now being produced. These are classed as nonwasting helium reserves. There are 39 fields in this category. The reasons for not producing these natural gas reserves are varied. Some are located in remote areas where pipeline connections are not available presently; in other cases, some of the gas is used for pressure maintenance operations to produce associated oil. In the majority of instances, the helium is in natural gas with low heating value and thus not valuable for fuel. The fields included in the first two groups will probably be put on production eventually, and the helium reserves will then be removed from the nonwasting category.

It is estimated that almost 9 billion cubic feet of helium is contained in the measured natural gas reserves of the nonwasting, helium-rich gasfields. Of this 9 billion cubic feet, about 5.6 billion cubic feet is contained in gasfields located on Federal lands. The Government retains title to helium under Federal oil and gas leases; therefore, title to this helium is held by the Government, even though the oil and gas rights may be leased. These nonwasting reserves, then, may serve as a backup to the helium stored by the Government and are an integral part of the Government's helium conservation efforts.

Helium in Helium-Lean Natural Gas

The AGA has compiled estimates of the natural gas reserves of the United States each year since 1945. The estimate for December 31, 1972,[2] was used in conjunction with helium contents derived from the gas analysis data from the Bureau's helium analysis files to estimate the volume of helium in the helium-lean measured natural gas reserves of the Nation. The AGA yearly reserve estimates and helium reserve estimates are shown in table 2 and figure 2.

Measured natural gas reserves of the United States were estimated by AGA to be 266,085 billion cubic feet as of December 31, 1972. This estimate was made by combining estimates of gas reserves of several geographic divisions within the country. Table 3 shows the gas reserve estimates for each geographical area as published by the AGA.

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[2]American Gas Association Committee on Natural Gas Reserves. Report of natural gas reserves of the United States. No. 22-73, Mar. 19, 1973.

TABLE 3. - AGA natural gas proved[1] reserve estimates with applicable helium content and helium in helium-lean gas

(Volumes in million cubic feet at 14.73 psia and 60° F)

Area	Natural gas reserves	Applied helium content, fraction	Contained helium
Alabama	245,714	0.00041	101
Alaska	31,455,443	.00015	4,718
Arkansas	2,455,877	.00087	2,137
California	5,328,862	.00007	373
Colorado	1,655,200	.00055	[2]730
Florida	180,629	.00030	54
Illinois	545,361	.00123	671
Indiana	87,324	.00117	102
Kansas	11,938,716	.00145	[2]424
Kentucky	938,082	.00125	1,173
Louisiana:			
North	3,320,328	.00035	1,162
South	71,651,006	.00006	4,299
Michigan	1,296,815	.00120	1,556
Mississippi	1,104,336	.00051	563
Montana	1,064,036	.00076	809
Nebraska	50,260	.00098	49
New Mexico:			
Northwest	8,160,874	.00027	[2]2,167
Southeast	4,174,773	.00039	1,628
New York	139,184	.00093	129
North Dakota	441,625	.00049	216
Ohio	1,146,677	.00147	1,686
Oklahoma	14,492,030	.00087	[2]10,795
Pennsylvania	1,406,948	.00082	1,154
Texas:			
District 1	1,620,405	.00019	308
District 2	9,496,136	.00006	570
District 3	20,696,874	.00006	1,242
District 4	24,334,110	.00006	1,460
District 5	1,171,395	.00032	375
District 6	5,710,441	.00038	2,170
District 7B	663,560	.00153	1,015
District 7C	2,581,980	.00099	2,556
District 8	15,481,337	.00039	6,038
District 8A	2,366,951	.00084	1,988
District 9	1,559,594	.00119	1,856
District 10	9,359,260	.00106	[2]2,879
Utah	1,022,110	.00051	[2]428
Virginia	35,921	.00098	35
West Virginia	2,345,957	.00080	1,877
Wyoming	4,088,728	.00032	1,308
Miscellaneous	269,987	-	-
Total	266,084,846	-	62,801

[1]See appendix for definition.

[2]Helium-rich fuel gas reserves subtracted from total natural gas reserves before average helium content applied.

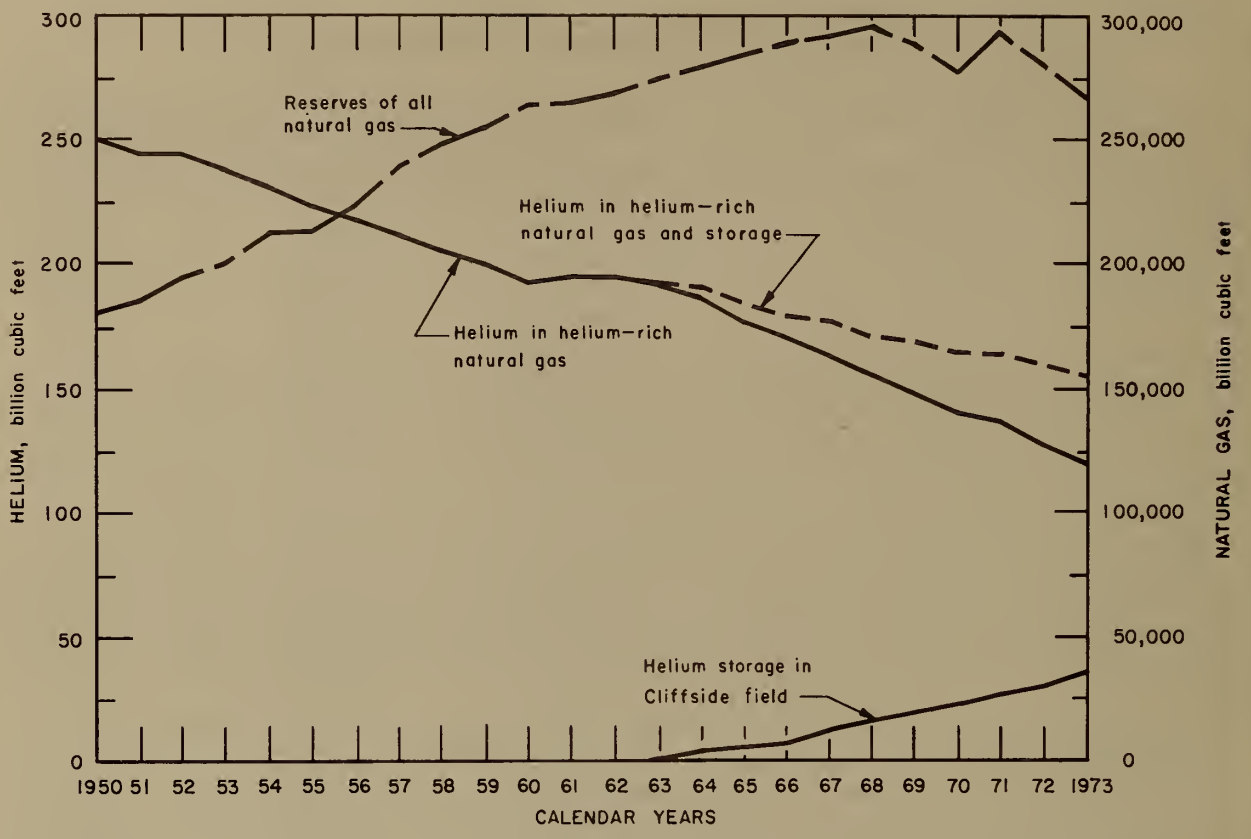

FIGURE 2. - Helium contained in helium-rich natural gas, helium in storage, and reserves of natural gas of the United States.

Gas analysis data from the helium analysis files were used to estimate an average helium content for the helium-lean natural gas reserves of each AGA reporting area. These average helium contents are shown in table 3. These values were then applied to the estimated natural gas reserves to estimate the helium contained in the helium-lean natural gas. In areas where the helium-rich natural gas reserves are located, these values were subtracted from the AGA estimates before the lean helium content average was applied. Total helium volume contained in measured helium-lean natural gas reserves of the United States is 62.8 billion cubic feet. A breakdown by geographical regions is given in table 3.

Helium in Potential Reserves of Natural Gas

The United States has large resources of natural gas that are as yet undiscovered, according to the PGC. Resources were estimated to total 1,146 trillion cubic feet as of December 31, 1972.[3] The PGC is sponsored by the Potential Gas Agency, Mineral Resources Institute, Colorado School of

[3]Potential Gas Committee. Potential Supply of Natural Gas in the United States (as of December 31, 1972). Potential Gas Agency, Miner. Res. Inst., Colo. School Mines Foundation, Inc., November 1973, 47 pp.

Mines Foundation, Inc., and is made up of representatives from the oil and gas producing industry, gas transmission industry, gas distribution industry, Government, and academic community. The Committee made its initial report on future natural gas supply in 1967, although a predecessor committee, Future Gas Supply Committee, produced a report in 1964.

The resources reported by the PGC are broken down into three categories: probable, possible, and speculative. The PGC defines these terms as follows:

"Probable - The most assured of new supplies results from the growth of existing fields.

"Possible - Less assured is the supply from new field discoveries in formations previously productive; such new fields would be distinctly separated from existing fields.

"Speculative - The most nebulous of new supplies is attributable to new field discoveries in formations or provinces not previously productive."

In comparing the PGC definitions with the terminology adopted by the Bureau of Mines and Geological Survey, it appears that the PGC "probable" class is closely related to the Federal "indicated" category. This would then bring the "probable" resources into the "identified" range on the chart on page 3. This is a seeming contradiction to the PGC's treatment of that class of reserves; however, it appears to be the best resolution. A geological Survey report discusses the PGC estimates stating on page 19 that the "probable category includes, however, some known resources, in the sense of having been discovered but not completely developed, and some unknown resources, so that this category brackets the boundary between the known and the unknown."[4] For the present report, the PGC "probable" category will be compared to "identified" reserves, and PGC's "possible" and "speculative" will fall in the "undiscovered" category in Bureau of Mines terminology.

To estimate the helium contained in the potential natural gas resources, as estimated by the PGC, average helium contents for the various PGC reporting areas (shown in figure 3) were applied to the estimates of gas resources. These average helium contents were again derived from the results of the Bureau's evaluation of helium occurrences and gas analysis. Helium contained in these potential gas reserves is estimated to be 476 billion cubic feet. Average helium contents used for the various PGC regions ranged from 0.006 percent to 0.178 percent. Table 4 shows the PGC estimate of potential natural gas resources by category of estimate and geographic area. The average helium content applied to the gas resources and the estimated helium contained in the natural gas are shown in table 5. It was assumed that the helium content of the gas discovered in the future would be the same as past discoveries in all PGC areas except Area J North. Area J North includes the Texas Panhandle, Oklahoma, and Kansas; consequently, the area contains over 90 percent of the proved or measured helium-rich gas reserves. Since it is not deemed likely

[4]Theobald, P. K., S. P. Schweinforth, and D. C. Duncan. Energy Resources of the United States. U.S. Geol. Survey Circ. 650, 1972, 27 pp.

that helium-rich gasfields of the size of Hugoton or West Panhandle will be discovered in the future, it seemed prudent to discount these large "reservoirs" when considering the helium content of future discoveries. Because of this, the weighted average helium content of the helium-lean natural gas streams leaving Area J North was used for the potential or undiscovered gas reserves.

TABLE 4. - Potential gas reserves of the United States as of December 31, 1972, as estimated by the Potential Gas Committee[1]

Area	Probable reserves	Possible reserves	Speculative reserves	Total U.S.
A	26	9	67	102
B	2	4	54	60
C	([2])	5	4	9
D	8	24	58	90
E	56	84	([2])	140
G	58	47	20	125
H	13	26	20	59
I	6	6	6	18
J North	21	39	24	84
J South	17	33	11	61
L	5	13	14	32
K	54	94	218	366
Total	266	384	496	1,146

[1]Potential Gas Committee. Potential Supply of Natural Gas in the United States (as of December 31, 1972). Potential Gas Agency, Miner. Res. Inst., Colo. School Mines Foundation, Inc., November 1973, 47 pp.
[2]No reserves.

TABLE 5. - Helium content and contained helium in the potential gas reserves of the United States

(Volumes in billion cubic feet at 14.73 psia and 60° F)

Area	Helium content, fraction	Helium in probable reserves	Helium in possible reserves	Helium in speculative reserves	Helium in total potential reserves
A	0.00108	27.93	9.66	71.97	109.56
B	.00042	.84	1.67	22.56	25.07
C	.00178	([1])	8.85	7.08	15.93
D	.00065	5.17	15.52	37.50	58.19
E	.00006	3.34	5.01	([1])	8.35
G	.00007	4.04	3.27	1.40	8.71
H	.00110	14.22	28.44	21.88	64.54
I	.00032	1.91	1.91	1.91	5.73
J North	.00109	22.77	42.28	26.02	91.07
J South	.00053	8.96	17.40	5.80	32.16
L	.00007	.35	.91	.97	2.23
K	.00015	8.06	14.17	32.67	54.90
Total	-	97.59	149.09	229.76	476.44

[1]No reserves.

FIGURE 3. - Publication areas for Potential Gas Committee.

DISSIPATION OF HELIUM RESOURCES

The Future Requirements Committee (FRC), sponsored by the Future Requirements Agency, has reported the results of a national biennial survey of gas requirements since 1964; the latest report in this series is entitled "Future Gas Consumption of the United States."[5] The purpose of these reports is to establish a system that will provide a generally accepted, continuing long-range analysis of natural gas requirements. The committee is similar in organization and structure to the PGC. Regional work committees survey companies within their area to determine their forecasts of future gas demand. The FRC natural gas consumption forecasts are shown in table 6.

TABLE 6. - FRC estimates of future gas consumption in the United States

(Volumes in trillion cubic feet at 14.73 psia and 60° F)

Year	Gas consumption[1]
1973	24.8
1974	25.0
1975	25.2
1976	25.5
1977	26.1
1978	26.4
1979	26.8
1980	27.1

[1]Volumes are based on natural gas having a heating value of 1,000 Btu per cubic foot.

To forecast available helium in natural gas produced for market, the average helium content for each area was applied to annual consumption estimates from table 6. Since FRC forecasts of demand estimates extended only through 1980, these demand estimates were extrapolated through the assumed depletion of the natural gas reserves that were estimated by the PGC. The extrapolated data were used to forecast available helium after 1980. These forecasts were made by PGC designated areas, and the results were compiled for all of the areas in the United States. This compilation is shown in figure 4 and table 6.

[5]Future Requirements Committee. Future Gas Consumption of the United States. Future Requirements Agency, Denver Res. Inst., University of Denver, v. 5, November 1973, 80 pp.

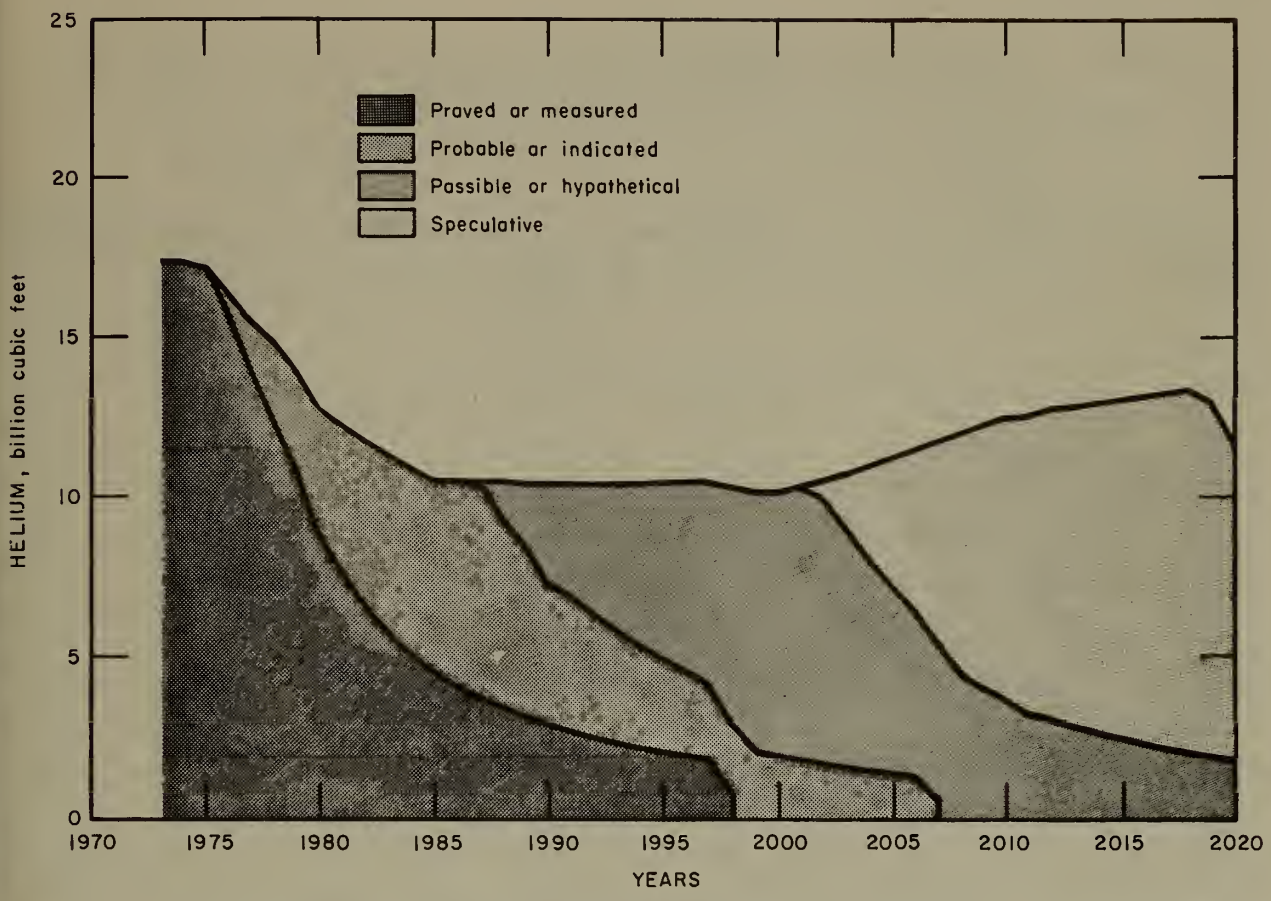

FIGURE 4. - Estimated helium in natural gas production from all resources in the United States.

Table 7 estimates the total helium contained in future U.S. natural gas production assuming that the natural gas resources estimated to exist by the PGC will all be discovered and that they will be discovered at the rate necessary to fulfill the demand, exclusive of imports and synthetic gas. Such forecasts must be qualified by several factors since discovery rates depend on many variables and cannot be predicted with a very high degree of certainty. Also, part of the total demand for natural gas will be filled by imports and by synthetic natural gas, and the volume imported depends on many changing conditions and is subject to great uncertainty. Finally, much of the natural gas demand over the period covered may go unfulfilled if the economic and other incentives do not materialize to encourage industry exploratory work to search for and find new gas reserves.

TABLE 7. - Total helium estimated to be contained in future natural gas production in the United States

(Volumes in billion cubic feet at 14.73 psia and 60° F)

Year	Helium	Year	Helium
1973	17.41	1997	10.58
1974	17.38	1998	10.34
1975	17.18	1999	10.19
1976	16.48	2000	10.27
1977	15.53	2001	10.38
1978	14.87	2002	10.58
1979	14.01	2003	10.78
1980	12.80	2004	10.95
1981	12.24	2005	11.18
1982	11.75	2006	11.43
1983	11.27	2007	11.66
1984	10.89	2008	11.98
1985	10.52	2009	12.22
1986	10.48	2010	12.39
1987	10.43	2011	12.52
1988	10.46	2012	12.67
1989	10.41	2013	12.81
1990	10.45	2014	12.94
1991	10.41	2015	13.08
1992	10.43	2016	13.25
1993	10.44	2017	13.34
1994	10.47	2018	13.47
1995	10.50	2019	12.98
1996	10.58	2020	11.72

CONCLUDING STATEMENT

In conclusion, it appears that relatively large volumes of helium will be available from natural gas through 2020. This helium, however, will likely be in leaner concentrations than the gas being processed for helium today. Helium extraction plants will have to process larger quantities of gas, and will probably be located on gas transmission systems which bring together, at one point, large volumes of natural gas.

The Bureau of Mines had over 31 billion cubic feet of helium in storage at the beginning of 1973. In addition to the stored helium, there are about 4 billion cubic feet of helium in the native gas in the Cliffside storage field owned by the Bureau. This helium, plus the helium now being extracted from the Keyes field in Oklahoma by the Bureau under a life-of-the-field contract, will serve to fulfill the Bureau's mission of supplying helium to meet all essential Government needs for many years beyond 2000.

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APPENDIX A.--GLOSSARY OF RESOURCE TERMS[1]

Resource.--A concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust in such form that economic extraction of a commodity is currently or potentially feasible. (A)

Reserve.--That portion of the identified resource from which a usable mineral and energy commodity can be economically and legally extracted at the time of determination. The term ore is also used for reserves of some minerals. (A)

Identified resources.--A collective term for the sum of materials in both measured and indicated resources. (A)

Measured.--Material for which estimates of the quality and quantity have been computed, within a margin of error of less than 20 percent, from analyses and measurements from closely spaced and geologically well-known sample sites. (A)

Proved reserves.--May be both drilled and undrilled. Undrilled reserves are located so close to the drilled reserves that every reasonable probability exists that they will be producible when drilled. Proved reserves are recoverable under existing economic and operating conditions. (B).

Indicated.--Material for which estimates of the quality and quantity have been computed partly from sample analyses and measurements and partly from reasonable geologic projections. (A)

Probable reserves.--The most assured of new supplies results from the growth of existing fields. (B)

Undiscovered resources.--Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory. (A)

Potential supply.--This is the prospective quantity of gas yet to be found or to be added to existing fields exclusive of proved reserves. (B)

Hypothetical resources.--Undiscovered materials that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a reserve or identified-subeconomic resource. (A)

Possible reserves.--Less assured is the supply from new field discoveries in formations previously productive; such new fields would be distinctly separated from existing fields. (B)

Speculative resources.--Undiscovered materials that may occur either in known types of deposits in a favorable geologic setting where no discoveries

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[1]See end of appendix for key to sources A, B, and C.

have been made, or in as yet unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality that will permit their reclassification as reserves or identified-subeconomic resources. (A)

Speculative reserves.--The most nebulous of new supplies is attributable to new pool or new field discoveries in formations or provinces not previously productive. (B)

Economic resources.--Those resources, both identified and undiscovered, that are estimated to be economically recoverable. (C)

Subeconomic resources.--Identified and undiscovered resources that are not presently recoverable because of technological and economic factors but which may be recoverable in the future. (C)

Key to Sources

A--Taken from the April 15, 1974, news release of the Department of the Interior entitled "New Mineral Resource Terminology Adopted."

B--Potential Gas Committee. Potential Supply of Natural Gas in the United States (as of December 31, 1972). Potential Gas Agency, Miner. Res. Inst., Colo. School Mines Foundation, Inc., November 1973, 47 pp.

C--Recoverable Oil and Gas Resources in the United States, by B. M. Miller, H. L. Thomsen, G. L. Dolton, A. B. Coury, T. A. Hendricks, F. E. Lennartz, R. B. Powers, E. G. Sable, and K. L. Varnes. (U.S. Geol. Survey Circ. 725, 1975, 78 pp.; free on application to the U.S. Geological Survey, National Center, Reston, Va. 22092.)

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